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Lightening the Diver's Load

WHEN peace shall finally have come, it would seem that we may expect a tidal wave of projects for the recovery of sunken vessels and cargoes, and as a corollary a great deal of interest in the technique of diving and the apparatus for the diver's use. This is one of the fields to which Germany, the nation of technologists, has paid much attention. During the past few years the great concern at Lübeck which supplies most of the diving equipment used in the Kaiser's dominions has developed a number of original and highly ingenious devices looking to the increased safety, comfort and efficiency of the submarine toiler. The Germans naturally claim outstanding advantages for all these; and even if we adopt the opinion of the average British or American diver that they are merely different from his equipment, and in no sense better, we must find them of great interest.

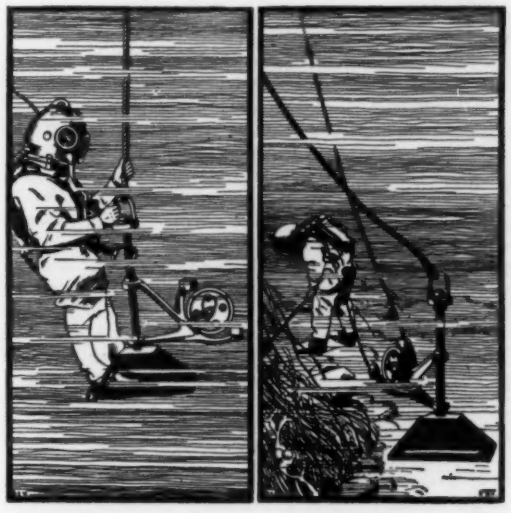
Perhaps the most important item, and one whose utility the most rabid anglophile would dispute with difficulty, is the deep water air-lock which we illustrate on this page.

From this it will be seen that this compartment is lowered from the surface, kept in communication with the vessel by means of an air-hose carrying telephone cable, etc., and that it serves as the diver's immediate base of operations. Its advantages are numerous. It can be used as tool-house, placing at the diver's disposal a much larger assortment of implements than he could otherwise have. Then if anything goes wrong with his suit or connections he can retreat to the air-chamber and there mend the damage or await rescue in comparative safety. Finally he is much less at the mercy of the rapid currents which are so common under the surface. It is plain that a vertical cable presents a far greater resisting surface to these currents than does a horizontal one. Moreover, the effects of strong currents upon the vertical cable are to drag the diver up to a higher level and make a sharp kink in his cable and hose. This danger is eliminated by use of the air-lock, for the latter can be lowered to the level on which the diver is to work, making all his connections horizontal.

The chambers are made in all sizes, for two or more divers, and for use in all depths up to 325 feet. Here are more advantages. This is a depth not attainable with the ordinary apparatus; and there is a great saving in cable and hose, with consequent decrease of the probability of failure, when a number of divers can be connected with the surface by a single line.

Having a direct and obvious relation to the air-lock is the self-contained diving suit. Equipped with this the diver is cumbered with no air-hose, and cannot be suffocated by the failure of the hose or the formation of a kink in it by current or other means. He carries his own air with him in a compression chamber strapped to his back; and to make his supply hold out for a much longer time than otherwise it would, he has an air-purification circuit, by means of which the carbonized air which he exhales is passed over caustic soda or potash, restored to its pure state by chemical reaction, and returned to his nostrils. This operation is repeated indefinitely.

For the diver who is making his immediate base on the ship, in the regular way, there is a device of rather amusing appearance but of considerable convenience. This is the ground-block which we picture. Its purpose is to relieve the diver of as much of the weight of his cable as practicable. It has a neat little platform cut into each side so that the diver can ride down to his work and ride back again in relative luxury; and when he has reached the bottom he sets his anchor up, passes his cable through a clip and about the pulley, and only has to drag about with him that part between himself and the reel, free of all danger and annoyance attendant upon the use of old-time diving apparatus.



Diver riding to work on his ground-block

At work, weight of cable supported by block

We have mentioned the possibilities of the air-chamber as a tool-house; and these possibilities have been pushed to the ultimate point by the Germans in the development of all sorts of tools for the diver's use. With all the apparatus which is now at his disposal, the diver is a veritable submarine machine shop. Drills, hammers, scrapers, in fact air driven wood- and metal-working tools of every description are his to use when he needs them. A most startling item, however, is the oxy-acetylene cutter for submarine use. The utility of this device in the hands of a wrecking diver is obvious; but the possibility of its employment in an atmosphere of water would perhaps never occur to the layman. It is done, however. The nozzle of an ordinary blowpipe is surrounded by another nozzle, leaving an annular space between the two, and through this space air is forced, pulling the water away from the cutting jet and making cutting possible. It is this apparatus which is being used by the diver pictured on our cover.

Divers working upon a submerged wreck, from an air-lock and in self-contained suits that do away with the necessity for air-hose

Relation Between Solar Corona and Prominences

THE solar corona consists of a brighter inner ring of great brilliancy, which is always present; of short and wispy polar rays; and of long streamers, constituting the outer corona. The variations in the form of the corona occur chiefly in the streamers, and these appear to run through a cycle corresponding to the 11-year sunspot period. At sunspot minimum the typical corona exhibits long wing-like extensions in the equatorial regions, while at maximum, several large streamers produce a star-shaped corona; at the intermediate epoch there are typically four principal streamers at about latitude 45, north and south. These variations in the corona are described in a recent memoir by A. Ricco, who proceeds to seek a relation between them and the observed variations in other solar phenomena. The regions in which the coronal streamers are especially developed do not coincide with the regions of numerous spots or faculæ on the sun's surface for any particular part of the sunspot period, but do coincide in a striking manner with the locations of prominences. The writer brings out this relation graphically by means of a diagram of frequency of prominences for various latitudes from July 1st to September 30th, 1914. On a circle representing the solar disk radii are produced beyond the circumference in proportion to the frequency of prominences for each 5 degrees of latitude. The ends of these are then connected and the outline is similar to that of the corona observed at the eclipse of August 21st, 1914. The coronal streamers are probably eruptive phenomena from the same regions of the sun as the prominences.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

When the European Worker Lays Down His Arms

IT is usually a very safe and logical procedure to base forecasts upon precedent. However, when we are confronted with a series of events which do not conform to any previous experience, we do not always break away from our habit of thought, but grope around for some precedent upon which to base our reasoning, with the result that our conclusion is often very wide of the mark.

Shortly after the great European War broke out its magnitude began to dawn upon us; we realized that it was smashing all precedents and establishing records of its own. Nevertheless, in considering conditions that will prevail immediately after peace is declared, we persist in basing our predictions upon the sequels of other wars.

In the past the disbanding of a great army has always been considered a serious matter. Men who had been torn from their occupations in peace times are suddenly thrown back into civil life and are expected to find their natural level in the work of the community. This calls for a readjustment of economic conditions which has always been attended with considerable confusion. It is natural to assume that such a state of affairs will ensue when the vast multitude of European soldiers lay down their arms. But there are certain factors to be considered which are not common to previous wars.

Ever since the European conflict started it has been reiterated that this is a war of machines rather than men; that victory will go to the side which can turn out the greatest number of guns and the largest quantities of ammunition; that this is a war of production, rather than destruction, for behind each army there must necessarily be a great industrial organization to furnish the men with fighting materials. Although we have heard this time and time again, have we really grasped its significance?

America has always prided itself upon its mechanical resources. To compete with the cheap labor abroad we have been forced to use machines which are fed on oil, which derive their power from coal and which demand no wages. We have led the world in the manufacture of machine tools. We have even prided ourselves upon the fact that if our mechanical resources were properly organized no other nation on earth would dare to engage in war with us. But ever since the Allies awoke to the fact that the war must be fought out in the machine shop, they have not only been placing orders for war material in this country, but have been buying our machinery, and have been building up vast plants of their own, filling them with American made lathes and automatics, drills, presses, grinding machines and no end of special machinery. In order to keep pace with the Allies we may be assured that the Central Empires have also been building machinery, accumulating a stock such as they never dreamed of possessing three years ago. Not only has Europe been stocking up its machine shops, but it has been acquiring a vast corps of expert machinists.

Aside from the machines and the men, it is evident that a most efficient industrial organization has been developed. We may pride ourselves upon the introduction of the science of industrial efficiency, but although this science has met with a fair amount of success in this country, Europe is profiting by our lessons of efficiency to an even greater extent than we are. A few years ago, when we attempted to introduce American efficiency methods into England, our efforts met with absolute failure. In Germany, however, after a brief preliminary period of distrust, the idea took and was eagerly carried out. Now that Great Britain sees the necessity of developing her industrial sources to the very highest pitch, efficiency methods are being pursued with vigor. The British press is eager to publish everything it can get hold of upon the subject. The results are to be seen in the enormous production of munitions in Great Britain, and we may be sure that they are being paralleled in the other principal fighting nations.

With these three factors in mind, namely, the machines, the skilled workmen and efficient industrial organization, it is plain to be seen that conditions after the war will not follow any established precedent. In Germany, in particular, where an autocratic government prevails, where the entire nation has been taught military obedience, we cannot imagine that at the close of the war, millions of men will suddenly be thrown out of military employment and be left to pick up such work as they can in their endeavor to reorganize the conditions interrupted by the declaration of war. Is it not far more likely that the industrial conditions of the country will be ruled in military fashion and built up into a great national trust in order to place that nation upon the road to success in the great economic struggle that lies before the world? This war has been immensely costly, sixty billions of dollars has already been expended. If we add to this sum the indebtedness of the fighting nations prior to the outbreak of hostilities, we find Europe saddled with debts aggregating ninety billion! With such an enormous debt hanging over them it will be imperative for these nations to undertake to reorganize their industries along national lines.

America has found it difficult to compete with Europe even under ante-bellum conditions. What are we to do when we have to compete with national industrial organizations? We may protect ourselves within our own borders by means of tariffs, but what are we to do with the export trade that we are now endeavoring to develop, is this all to be lost? Already we have begun to prepare for foreign competition in foreign markets. A bill which passed the House in September provides for combinations of capital in our export trade which will not affect free competition within our borders. This bill is now before the Senate. It aims to furnish us with the means of competing with foreign trade organizations. But back of it all, we must not neglect the importance of using every means at our disposal to develop our industrial efficiency to the highest degree or we shall lose the great promise of world-wide success that now lies before us.

Dewey

THE outbreak of the Spanish War found Commodore Dewey in command of our Asiatic fleet in far-eastern waters. Whether or no it is opportunity that makes the man, we do know that man must seize the opportunity and this Dewey did. It was his rare combination of foresight, initiative and energy, expressed in swift action and diplomatic tact during an extremely difficult situation, and above all, the courage to cut himself loose from headquarters in Washington and rely upon his own judgment of the situation as it might develop—it was all these things combined, that have given to Dewey an unassailable position in the annals of naval history.

Although in the popular mind the annihilation of the Spanish fleet at Manila was the feat which entitled him to be recognized as a popular hero, the naval historian of those momentous days will always realize that the mere sinking of the Spanish gunboats was, after all, but one event among the many that came crowding fast, one upon another—all of which called for the exercise of something more than the mere fighting ability of a commander of a cruiser squadron. Cut off, as he was, by 7,000 miles of land and water from Washington, Dewey, in those eventful days, had to be as much diplomatist as seafighter; and the general public little understands that in a situation such as that, a naval officer has to put to the critical test that intimate knowledge of international law and custom, which forms one of the most important elements of his training at Annapolis. At such a time difficult situations arise which call for the exercise of well-balanced judgment, quick decision, and immediate and bold action. His handling of the situation in all its complicated and difficult developments was masterly throughout; and the record of this gallant officer, from the time he gathered his squadron in the neighborhood of Hong Kong, to the day of the arrival of the American transports and the landing of our troops at Manila, added one more chapter, and that a brilliant one, to the record of the officers of the American Navy.

The squadron which gathered under his flag at Hong Kong consisting of four protected cruisers and three gunboats, was remarkable for its heavy gun-power—a distinctly American characteristic. His flagship, the "Olympia," for her size, was the most powerful unarmored cruiser of that day, and in this respect he possessed of course, an enormous advantage over the Spanish fleet which he had been instructed to hunt down and destroy. Outside of this fact, everything was against him. He was many thousand miles away from any base; he had an insufficient supply of ammunition; and he was short of coal. The last problem he solved by the purchase of a couple of British colliers.

He presumed that the inferior Spanish fleet would take refuge in Manila Bay, and under the shelter of the shore batteries, among which were guns of greater power than any carried by his squadron. He knew that the entrance to Manila Bay was dominated by the forts of the enemy, and he had reason to suppose that he would find that entrance carefully mined. The story of his passage by night past the harbor forts, of his engagement of the combined Spanish ships and batteries at Cavite, and of his complete annihilation of the Spanish fleet, is too well known to need any repetition.

It is probable that not even Dewey himself realized that when his guns thundered forth on that memorable Sunday, May 1st, he was breaking down that wall of international isolation with which this country had surrounded itself during the past century of its existance; or that his victory at Manila, coupled with that of Sampson and Schley at Santiago, was destined so far to extend the boundaries of the United States that, by the close of the war, they would be thrown 1,000 miles eastward into the Atlantic and 5,000 miles westward across the Pacific, even to the very doors of Asia. For such, indeed, was the result of a war which was won mainly through our quickly achieved and never disputed command of the sea.

It was largely because of a certain touch of romance associated with the far-distant Manila campaign, that Dewey became the popular naval hero of the war and secured a place in the hearts of the American people, which he held to the day of his death.

In recognition of his victory, he was immediately given the rank of Rear-Admiral, and he was further promoted to the rank of The Admiral of the Navy, which was created expressly for Dewey, in March 1899, a position which had been held by only two of his predecessors, Farragut and Porter.

Citizenship and Preparedness

IN agitating the subject of preparedness, the country, true to form, again has demonstrated that a salient characteristic of the American people is belief in the outward form rather than the inner spirit; and it would appear to be high time that attention were invited to the rather shell-like condition of our present preparedness structure. This should be done while we are yet in position to reconstruct the foundation, without too much waste in scrapping the results already achieved.

The campaign carried on by unselfish citizens for upbuilding the defenses of this country was successful beyond all expectation; and to discredit this success is not at all the object of this discussion, but rather to attempt to connect this success with other endeavors and other successes, so that when we shall have arrived at our goal, "complete preparedness," there shall be a stable structure, with an efficient and dependable foundation. The true foundation, as we see it, consists in a proper conception of citizenship.

What of the psychology of citizenship? What have we done to train the mind of our citizens as to national thought, and national obligation? Why is it that we have legislated an army into being and are still without an army or any immediate prospects of having one? Why is it that, with an immense appropriation for naval development we yet have no assurance of having this program completed in anything like reasonable time? Why is it, that, notwithstanding the wonderful results of our attempted mobilization of the industrial equipment of our country on paper, we have as yet, no industrial mobilization? It is entirely and solely because we have not built from the foundation. We have neglected to lay the cornerstone, without which no building will stand. We have omitted the keystone in the arch, without which, no arch will remain an arch. WE HAVE NEGLECTED THE MIND OF THE NATION.

With France thrilling the world from day to day by her exhibition of the appreciation of individual obligation in citizenship; with her astounding demonstration of unity of national thought without the curse of militarism; with her proof of the possibility of "providing for the common defense" and "promoting the general welfare" while maintaining national unity, personal equality, and individual freedom, we have passed over the cause and considered only the effect. We have thought that her success was due to an army; therefore, we legislate an army into being. We have assured ourselves that industrial preparedness has been demonstrated by all belligerents to be a prime factor; therefore, we arrange a paper industrial mobilization. We notice that Britain's Navy has been an essential; therefore, we legislate ships and men. Now we sit down and take our ease because forsooth we have "Military-Preparedness," "Naval-Preparedness," and "Industrial-Preparedness." Heaven save the mark!

In other words, "George" will now take the center of the stage and "do it." All our recruiting stations are now looking for "George," and "George" does not appear. Why? Because we have forgotten to teach "George" that he has any obligation to appear, and "George" is busy at his own affairs, just as you and I are busy with our own affairs, and just as we will continue to be busy until our minds receive the training which every citizen's mind should receive from his country, the training in OBLIGATION TO SERVE.

Electricity

Electric Traction in Buenos Ayres.—According to an article in *The Times* Engineering Supplement, the tramway system of Buenos Ayres is the largest of any one city in the world, there being some three hundred and thirty miles of line in operation, using over two thousand cars, and yielding an annual revenue exceeding ten million dollars. This is a remarkable fact when it is recalled that the population of this Argentine city is only about one and a half millions, whereas in London, with over seven millions, the County Councils' receipts are not much higher.

Wireless Telephony and Power Transmission.—The Drainage Board of Chicago has authorized the installation of wireless telephones at the generating station at Lockport, Ill., and the receiving station in Chicago. The energy is transmitted from Lockport to Chicago at 44,000 volts pressure, over a twin-circuit transmission line 32 miles distant. At certain seasons of the year lightning is extremely severe, putting the telephone lines out of commission; and it is to overcome this difficulty by insuring communication at all times that the wireless telephones are to be installed.

The New York Electrical Society held its 352d meeting on January 15th, at the Choralcelo Galleries in New York. Edward R. Knowles lectured on "Dust, Its Universality, Its Conservatism, and Its Elimination," giving some new and valuable data on the subject as well as indicating the part played by electricity in the most effective method of dust separation. After Mr. Knowles' address Guy P. Norton spoke on the operative principles of the Choralcelo, the music of which is produced electrically, and a program of the music was rendered. Mr. Norton explained how the various tone values were produced and modified and colored.

Electricity in the Manufacture of Doll's Heads.—After dolls' heads and all the other parts have been molded, it is necessary to dry them thoroughly before the coloring and other phases of the work can proceed. Under the old process it was customary to place the heads on racks and let nature do the rest, which meant that much time was lost during damp weather, not to mention the fact that the plastic heads often lost their shape from standing too long. To-day the dolls' heads are placed in drying boxes at one end of which is a refrigerating coil and at the other a motor-driven blower. Maintaining a current of air through each drying box, the blower causes the moisture to freeze when it comes in contact with the refrigerating coil. In this way the parts are subjected to a continuous circulation of cold, dry air which causes them to harden in a short time.

Recent Steps to Overcome Electrolysis.—The electrolysis survey of the city of Omaha, Neb., by the United States Bureau of Standards was completed a few weeks ago and a report is being prepared to show the measures that must be taken to remove the difficulty. The bureau acknowledges valuable coöperation on the part of the various utilities involved in this work, which promises to have especially important results. The engineers of the Bureau of Standards are also examining the installation at Springfield, Mass., to see how nearly the results agree with predictions made from the design of their system. If everything is satisfactory, the same system will be installed throughout a large part of the city of Springfield. The experimental station is in West Springfield, and the work is attracting considerable attention from electrical engineers in other cities.

Magnetic Uniformity.—Magnetic standard bars are used for the calibration of permeameters and the comparison of methods of magnetic testing with a standard method. One requisite of a magnetic standard bar is that it shall be magnetically uniform along its length. If this condition is not met, errors may arise which can not be calculated or eliminated from the measurements, and which may be of considerable magnitude. The degree of magnetic uniformity of a bar may be determined from observations of the distribution of magnetic leakage along the length of a specimen when it is magnetized between the poles of a suitable electromagnet. The degree of uniformity is indicated by values of the rate of change of leakage along the length of the bar. Deviations of these values from a constant indicate the presence of nonuniformities. An increase in the value indicates a magnetically hard spot, while a decrease indicates a soft spot. The degree of uniformity can be indicated by means of a curve plotted between values of the rate of change of leakage and displacement along the bar. This curve is called the uniformity curve and for a uniform bar is a straight line parallel to the axis of displacement. Errors in magnetic measurements due to nonuniformities depend upon the induction, the nature, location, magnitude and extent of the nonuniformities and upon the type of apparatus. For a given accuracy no ordinate of the uniformity of curve must deviate from the mean by more than a given amount. This method may be applied to the examination of magnetic materials for mechanical inhomogeneities and the detection of flaws.

Science

Delinted Cotton Seed.—The unusual demand for cotton lint by the munitions factories has recently greatly increased the delinting of cotton seed, and the cake and meal made from such seed has usually much less protein than that made from undelinted seed. According to the Department of Agriculture, many mills, in labeling their product, used the analyses of former years, thus misleading the consumer. Action has been taken by the department and by state officials to remedy this evil.

Miners' Consumption, also known as silicosis, has been the subject of investigations carried out by the Public Health Service in the Joplin (Mo.) mining district. According to the last annual report of the service, this is an important occupational disease of the metal mining industry in America. Men exposed constantly to silicious dust for 5 years are fairly certain to be found in the first stage of silicosis, and an average of the records of 28 deaths indicates that the victim of miners' consumption may be expected to die within 10 years of beginning exposure to silicious dust. In the Joplin district it is believed that about 35 per cent of the whole body of miners is affected with silicosis.

A New Method of Packing Cotton Goods.—Shanghai firms in the cotton piece-goods trade were interested recently in the opening of some bales of white shirtings which instead of being packed in tin-lined cases, as has been the custom in the past, had been shipped in bales. The experiment was made on account of the great and increasing cost of packing cases and lining in Great Britain. Except for a few hook holes, the shipment was in perfectly good condition; but doubts are expressed as to the acceptability of the new method in the Chinese market. Conservative Chinese buyers consider it a very decided change and they also claim that the burlap is insufficient protection for the goods that are to be sent long distances into the interior after arriving at Shanghai. On these portions of the journey, as might be expected, the handling is most rough.

Earthquakes in the United States.—Thanks to the establishment of a national seismological service in connection with the Weather Bureau, the United States is no longer notorious as an important civilized country in which earthquake data are not systematically collected. The collection and publication of such statistics for the United States has been in progress since December 1, 1914. Non-instrumental reports are rendered by the 200 regular stations of the bureau and by most of the 4,500 coöperative stations. The bureau also publishes the records obtained from its own seismographs at Washington and at Northfield, Vt., as well as from the instruments belonging to eighteen other institutions, distributed from Panama to Alaska and from Hawaii to Porto Rico. During the calendar year 1915 the number of earthquakes felt within the United States proper was 150. Some three or four of these were distinctly severe, though only two occurred in populous regions.

Sanitary Commissions in the Philippines.—Sanitary work in the Philippines has now assumed the intensive form of appointing sanitary commissions to make detailed examinations of the conditions in each town and draw up appropriate plans relating to water-supply, sewage disposal, personal hygiene of the natives, and other sanitary matters. This work was begun in June, 1915, and two commissions have since been in the field. Six towns have thus far been investigated. In the early days of American occupation sanitation was devoted chiefly to the elimination of grave epidemic diseases, such as cholera, smallpox and bubonic plague. Smallpox and plague have been, for all practical purposes, banished from the islands, while cholera has been effectively controlled and can never again, it is believed, assume serious epidemic proportions. In 1906 a general study of the water supply was begun, and in the following year the first artesian wells were put down. There are now more than 1,200 of these wells, furnishing satisfactory drinking water.

Motion Pictures and Eyestrain.—The effects of frequent attendance at the "movies" on eyesight have recently been discussed in some detail by Mr. Gordon L. Berry, acting secretary of the National Committee for the Prevention of Blindness. His principal conclusions are that (1) motion pictures with defects of photography, manufacture and projection *may* prove injurious to eyesight, and (2) eyestrain caused by viewing motion pictures may indicate a subnormal condition of the eyes which should demand immediate attention on the part of an oculist; in other words, such pictures, while not the chief source of the trouble, may reveal its existence. Some conditions favorable to the protection of the eyes are a plate glass screen, an auditorium as light as may be consistent with securing satisfactory detail in the pictures, and a seat in the center of the auditorium and never nearer to the screen than 20 feet (the further back the better). Without the best screens, films, projection, surrounding illumination, and seating arrangements, the "movies" are likely to prove a cause of serious eye troubles.

Automobile

Economical Production.—One large automobile company employs 17,000 men, and turns out 1,000 cars a day. This would mean that one day's work of 17 men is all that is required to produce a complete car at a labor cost of say $85. Of course, such is not actually the case, but it illustrates the economy possible when manufacturing is carried out on a large scale with the latest facilities.

Europe's Supply of Carbide.—It is said that Norway, with its cheap waterpower, is the chief source of the carbide used in European countries, while Italy has been supplying quite an appreciable quantity. In England the production heretofore has been about two thousand tons; but a new factory is now being erected that will be the largest in Europe, and will fully meet all the demands of that country.

Indiana Protects Its Roads.—To a certain extent the state of Indiana has made provision for protecting its roads by imposing fines for hauling loads over specified weights on tires under a prescribed width. Thus the limit for a 3-inch tire is set at 2,500 pounds and for a 5-inch tire 3,800 pounds. While these limits for tire widths may be suitable for horse-drawn vehicles that travel at say not over five miles an hour, they hardly appear sufficient for speeds of fifteen miles or over, which are sure to prevail as trucks come into more frequent use outside of the large cities; and it would appear that speed limits should be prescribed for heavy vehicles, as well as the other regulations.

Road Destruction by Heavy Vehicles.—In connection with the question of the injurious effect of heavy vehicles on highways some observations made in England are to the point. *The Autocar* recently commissioned two experienced men to investigate the matter and they made their observations on one of the main roads, well away from the city traffic. They found that a number of heavy motor busses were being run at over 22 miles an hour, while several solid tired commercial vehicles were operated at from 21 to 25 miles an hour. Moreover 3-ton army trucks were seen making from 24 to 26 miles an hour. When the road is new and smooth the damage done by these vehicles is not very apparent; but as soon as a little irregularity occurs these ponderous vehicles simply leap off the ground in passing over them, only to drop with a grinding shock a few inches farther on, when the wheels can be seen to scoop out the surface at every jump. One thing is certain, that these heavy vehicles do not pay their proportional share for the upkeep of the roads; and while it is not intended to suggest that public highways should be restricted to light pleasure traffic, there is no question but that the use of the roads should be so regulated that they shall not be destroyed for the profit of the minority, and that an equitable adjustment of the expenses should be made.

Good Roads and Heavy Vehicles.—We have hardly got well started on a universal system of good roads before they are menaced by new developments in motor vehicle construction. Taking advantage of improved road surface motor truck makers show a tendency toward an increase in the size and carrying capacity of their vehicles, and this increase in weight together with the high speeds at which they are operated, threaten the rapid destruction of our new roads, which were never intended for the weights that are gradually being imposed upon them. Indeed it would be impossible to construct any ordinary road to stand up under the ponderous motor vehicles in use.

An example of what may easily happen anywhere is to be seen in New York. A contractor's truck is in use there that weighs, loaded, 19 tons, of which 13 tons are carried on the rear wheels that have 8-inch steel rims. In one street that it passes through constantly it is run at a speed of from 15 to 20 miles an hour. The result has been that an entirely new granite block pavement has been actually crushed, splintered and destroyed in a few months. Moreover, even when running at low speed, these juggernauts loosen every paving block the wheels pass over, breaking the joints and opening up innumerable passages that admit water to the foundations.

Our roads and pavements were never intended for trucking of this description, and it is nothing short of attempting to do railroad work on a highway without incurring the logical expense of maintaining a track, for nothing but a steel track would stand up under such traffic. Various suggestions have been made for building steel plate highway tracks, but no one has yet offered a feasible, nor a practical plan, and as a matter of fact such tracks are only required for excessive loads that should have no place on a public highway, and road users at large should not be taxed to build and maintain roads of a description that are of benefit solely to a small minority of the traffic.

The remedy for this impending destruction of our roads is the passing of regulations strictly limiting the loads that can be put on the highways, and limiting the speed of heavy vehicles in proportion to their weight and this should be done soon.

Dredging coal on the Lehigh

Sub-Aqueous Mining of Anthracite Coal

How Pennsylvania is Cashing In the Waste of Previous Generations

By P. A. Roche

Closer view of a Lehigh coal dredge

WILL it be considered a far cry in dealing with the retrieving of the waste of one of our great industries to hark back just fifty years ago and read with wonder in the *Anthracite Mining Journal* that it would be money in the operators' pockets to dump chestnut coal on the culm pile as refuse, together with the smaller sizes, because it interfered with the economic marketing of the larger sizes? Yet, such assertion was made in all seriousness in 1866 by an anthracite mining journal. To-day we read in the *Mauch Chunk Times*, October 31st, 1916, of the shipping of anthracite in sealed box cars, so valuable has coal become.

"The Black Diamond" is perhaps no very exaggerated misnomer after all. Present day conditions as to utilization of the smallest bit of the now precious anthracite are so acute that we find in actual operation plants to recover from river beds by sub-aqueous mining the fuel that for nearly three generations was buried under water in many of the streams that flow through the extensive anthracite coal regions. True, there is not the glitter of the freshly mined "Black Diamond" on the smooth surfaces worn by attrition, as the "refuse" was swept by freshets and by the constant daily flow of the river current, but the combustion value of the dredged coal is in nowise impaired, for it happens that the product is the best coal of the mines. Nature, through the laws of specific gravity, has put the lighter coal above the top of the heavier mineral matter with which it may have been mixed in the mine, together with the eroded elements of the banks and beds of creeks and rivers as they flowed into spots where subsidence took place.

Everyone is familiar through pen description and photographs, with gold mining by means of dredges and other appliances in the sands of Cape Nome, Alaska. Here in this country, about a three hours' journey by railroad from New York, we have counterpart of some of the methods of sub-aqueous mining common now in our far Arctic possessions. These deposits of coal—the term is quite accurate indeed—found in deep layers just above dams and in pockets where small river whirlpools existed, are easily reached; and the centrifugal pump, traveling bucket conveyor, and even the Archimedes screw are now winning between half a million and a million tons yearly of what man in his wastefulness let escape. Reasons economic and legal are instrumental in bringing about the retrieving of waste. High prices of everything needed to put Anthracite into our furnaces and stoves, as well as stringent laws prohibiting the choking up of natural water courses, with a growing desire to rid the mining country of the culm-heap eyesore, are potent in furthering the reclamation of nature's discarded treasures.

Just as the history of every maturing and matured industry shows the beginnings to have been small and humble, so it is in this industry of sub-aqueous mining for coal. The ones who might be considered pioneers were not always even of the mining class, but farmers and dwellers along the streams that threaded the mining country and places outside of it. Indeed, there are dozens of small individual plants operating in localities about a score or two score miles from the spots where the coal is dug out of the earth.

A riverside dweller would take out a flat-bottomed boat, and scoop up with a shovel rich coal dust from a shallow pocket or pool into his boat and dump the cargo on shore. The water would drain off and behold the coal pile, ready for use in his kitchen stove. Ingenuity suggested the means of using to advantage this fine grained coal—rice or bird's-eye as we call it now. An ample chimney, sticks of driftwood mixed up with it, and a little nursing after kindling would give a red-hot fire, with practically no ashes when combustion was complete—all without a cent of money outlay to the water miner except the investment of a few dollars in some planks thrown together in building his boat, which he would oftener use for other purposes than for harvesting his coal supply. This was a common practice a little more than a generation ago, and still continues in some localities, but the riverside miner on the whole, is not so frequent nowadays.

Capital, however, took a leaf from his book, and the steam pump, with barge and towboat have supplemented and perfected the earlier methods of reclamation. In the Schuylkill region was initiated the move towards a more systematic modern handling of coal laden river bottoms, and it may be remarked that the past half dozen years saw a great increase in the number of dredging plants throughout the anthracite coal country. The plants investigated by the writer and shown in the photographs are now operated by companies, all seemingly independent of the owners and operators of mines. No land is to be purchased as for surface mining; no driving of shafts, no cutting of chambers and slopes, no erection of costly breakers, and in many cases no payment of royalties. The investment of $2,000 in a pumping plant and some ancient canal boats, or of about $3,000 or $3,500 for a pump and a towboat with its complement of scows, and the river operator is equipped for work.

Sub-aqueous coal flats which are actually exposed in low water

Waterway in the culm heaps. In wet weather much coal is washed down into the creekbed

Pumping coal from the river bottom

In the Mauch Chunk plants visited, these two kinds of equipment were used according to which side of the river was to be worked. Of that contiguous to the canal of the Lehigh Coal & Navigation Co., a towboat was not required because the coal was poured into canal boats, which by means of the convenient waterway and the omnipresent canal mule were landed at the nearby destinations. The towboat and scow arrangement with the dredges anchored in midstream was necessary on the opposite side of the river about a thousand feet from the canal, the coal being conveyed from the water's edge by traveling belts and loaded into coal cars, and, like that transported by canal, brought to a market almost on the spot furnished by the local industries. From the pumps and conveyors the coal passes into a revolving cylindrical screen tilted at a small angle. The screened and cleaned particles pass into the canal boat or scow lashed alongside the pump outfit, while the water, carrying clay and other substances runs off into the river at a convenient distance from the pump's intake. The screens, 16 feet long and 30 inches in diameter, are made of steel wire ⅛-inch thick and woven into ½-inch mesh.

At the most liberal estimate the cost of getting the coal out of the water is 12 cents per ton. The price paid by one consumer who uses nearly the whole output of two of these plants, each consisting of one battery of pumps, is $1.35 per ton at the point where shipment begins. A good showing is surely made here, and the supply taken out at present does not meet the demand, for the coal is in right condition without further preparation for the peculiar discriminating needs of this consumer's industry, to say nothing of its adaptability for steam use if necessary. The freedom of this fuel from actual dust and clinker forming material, to say nothing of its high carbon content, makes the firing of steam boilers in which it has been used a more cleanly process. The result of one series of tests with it and buckwheat shows the percentage of ashes was three of the former as against twelve of the latter. As to the future supply in the locality mentioned, an operator declared that during his five or six years of work the accumulation of coal under the river water could be considered as barely touched, and that the quantity spread over an area, roughly estimated, at between one hundred and one hundred and twenty acres, and from ten to twenty-five feet in depth, was sufficient to last fifteen years on the basis of three hundred tons dredged per day. This, for the coal actually in sight, to say nothing of the waste carried by surface flushing of culm heaps higher up the river, and collected in the river. Several of the culm heaps made up of all sizes from buckwheat to bird's-eye, seamed with crevasses of depths from one foot to fifteen, speak conclusively for the replenishment of the sub-aqueous fields scattered twenty odd miles below, through the ordinary action of rain and creek currents.

The Susquehanna and the Schuylkill as well as the Lehigh are surrendering the buried coal. With closer and more scientific working up of the coal as it comes from the mines the ugly, disfiguring culm dumps spread over a naturally picturesque landscape will be a thing of the past, and perhaps our small industry may eventually be relegated there too, but hardly for a generation or more.

Are Cattle Poisoned by Oaks?

A DISEASE of cattle prevalent in Utah is known popularly as "oak poisoning" or "summer sickness," and has been ascribed to scrub oak, which grows in great abundance over certain parts of the ranges. Other regions of the West and Southwest report heavy losses of cattle from oak poisoning. The Bureau of Animal Industry, after a careful and thorough investigation, has undertaken elaborate feeding experiments to determine how much truth there is in the idea that oaks are poisonous to cattle.

Scientific Sponging

One More Conquest for Intensive Industry Made by an Englishman in Florida

By Norton S. Roberts

THE oyster men of Florida have come to realize that they cannot depend upon the natural supply in years to come. They perceive that conservation is necessary, and they are now beginning to plant and cultivate the bars which have been more or less depleted.

The sponge industry of that State has been in much the same fix. It was in danger of death, maybe not next year or the following year, but ultimately, in the absence of some means to promote the growth of the sponge. Like a thunderbolt out of a clear sky came the savior of this industry in the person of Charles W. Chase, an Englishman by birth, but a Floridan by choice, with a scheme that is revolutionizing the sponge industry.

This question of the propagation and culture of sponges was given earnest consideration by our government, and many experiments in sponge culture were undertaken as far back as 1880. The fact that a live sponge could be subdivided, and the parts made to grow has been known for many years. Numerous attempts have been made to put this knowledge into practical use, but two difficulties have always stood in the way—first, that of a suitable anchorage for the cutting, second, that of a proper location. The raising of sponges from eggs had been successfully demonstrated, but its cost was too great to venture it successfully on a commercial scale.

Finally, success was achieved by Dr. H. F. Moore, of the Bureau of Fisheries. For seven years he experimented, and at the end of that time he demonstrated that sponges could be profitably grown under the following conditions and under them only:

(a) Complete absence of fresh water.

(b) Protection from marauders.

(c) Freedom from sand.

(d) Fastened to concrete disks about 10 inches in diameter and 2 inches thick, by means of lead or aluminum wire.

(e) In water shallow enough to make planting and harvesting not too difficult.

This announcement was received with enthusiasm, but no Floridan was willing to take the initiative. They were too sure that it could not be done because too many others had failed. Mr. Chase was not a "Doubting Thomas." He had followed Dr. Moore's work and believed in it.

No blare of trumpet or display of big type proclaimed Mr. Chase's inflexible purpose. Very quietly and assiduously he set to work and secured the waters of Sugar Loaf Sound, the only logical location possessing all of the requisites for successful sponge growing on a commercial scale. Bays on or near the mainland would not do, as there was danger of an influx of fresh water. The failure of one of his predecessors' work at Anclote, caused by a back-up of fresh water from the Anclote River, forever settled his mind against securing any other location than one where only salt water was available in an uncontaminated state. Such a location as this was the one he afterwards purchased.

Many pessimists advised him to be careful. Men who had spent years in the sponge business laughed and predicted a failure. But he pinned his faith in the government's experiments and finally secured the necessary capital needed to carry on the work. Early and late he has made his experiments, and patiently conducted his investigations, with unswerving determination and unfaltering faith in ultimate success.

The new industry of sponge-propagation has resulted in a little made-to-order town, owned wholly by the company. It has handsome up-to-date concrete residences, office buildings, stores, machine shops, a boat-building shed, marine ways, houses for the employees, ice and refrigerating plant, telephone lines, disk factories, terrapin runs, lime and fig groves and a truck farm. The Florida East Coast Railway runs for five miles across its property, and when shipping begins in earnest the industry will have direct connection with the great trade centers of the country.

The company could have paid a dividend last year, but the stockholders decided to cut up all the sponges now growing. Sponges of three years' growth will average about ten cuttings each, and the 630,000 growing sponges to which they pointed with pride last year will mean 6,300,000 sponges in a little over three years. They plan not to place a single sponge upon the market for another three years, when they will be able to enter it as a power with an annual output of at least two million sponges.

These sponges, like so many things cultivated, are superior to nature's products, for they are not damaged by the hook or divers. They do not have to be torn from coral rock bases, or cut or trimmed, and are consequently the most perfect sponges in the world.

A prominent Floridan recently said: "It took a man from Maine to show us how to raise oranges; a New Yorker took the initiative in the development of our east coast; and now an Englishman is teaching us how to grow sponges."

A cultivated sponge. Note the cleanly felted bottom, the best part of the sponge

Harvesting sponges that have had but a single year's growth

Cutting up the live sponges for seed. each sponge making ten cuttings

Fastening sponge cuttings to concrete disks for planting

Preventing Food Spoilage by Warring on the Guilty Micro-Organisms

THE recent report of the Chief of the Bureau of Chemistry, U. S. Department of Agriculture, indicates that extensive research and experimental work directed towards the prevention of spoilage of food products was done in that bureau last year. The work was directed along three principal lines: First, scientific investigations to isolate, identify, and learn the habits and methods of work of the micro-organizations or minute bacteria, molds or yeasts which produce spoilage. There are many varieties of these tiny organisms and each variety acts in its own particular way. Second, experiments to determine the best methods of sterilization, refrigeration and sanitation to prevent the growth of micro-organisms which have been isolated, identified and studied. Third, the application to particular foods on a commercial scale of the principles of sterilization, refrigeration and sanitation previously worked out experimentally in the laboratory.

A study was made of the organizations causing spoilage in canned sardines. The loss to individual packers of sardines from swelling is sometimes as high as 30 per cent of the pack. It was found that the organism causing the spoilage very rapidly forms spores which are killed at high temperatures. Experiments showed that when the cans were heated to high temperatures the spores were killed and no swelling or spoilage resulted. In addition to processing at high temperatures, it is necessary to use cleanliness in preparing and packing the sardines. The sardine industry has largely adopted the recommendations of the bureau as to the correct methods of handling, preparing and packing the sardines with the result that much loss from spoilage has been prevented.

Experiments were made in connection with the shipment of fresh shrimp. It was found that when prepared in a cleanly manner, suitably boiled in brine, and thoroughly cooled, the shrimp could be shipped for long distances in a prime condition. Many of the shippers have adopted the recommendations of the Department as to the proper methods for handling the shrimp and found them of great value in the conduct of their business.

Studies to prevent decay in fish have been continued. Perhaps no other perishable food is shipped long distances with so little knowledge of what is required to insure arrival in good order. The work was begun in Florida and at the end of the shipping season transferred to the Pacific Coast where transcontinental hauls are under observation.

In order to prevent spoilage in the shipment of poultry and eggs, a precooling plant has been developed, cooled by ice, capable of chilling 15,000 pounds of eggs and poultry a week. This plant costs approximately $800 to install. With ice at $3.00 per ton it has been found in actual commercial use to effect a saving of at least $22 per carload in handling and chilling. It also enables the small shipper who cannot afford to erect a complete refrigerating plant to compete with the largest shippers.

The work upon the transportation of perishables has been facilitated by the improvement of the method of installing resistance thermometers in refrigerator cars so that the temperature of the interior of a considerable number of cars may be observed simultaneously. In the study of the cold storage of eggs particular attention has been paid to the devising of methods to prevent stored eggs from acquiring the so-called "storage taste."

Estimating Stellar Magnitudes

AT the fourth annual meeting of the American Association of Variable Star Observers, held recently at the Harvard College Observatory, an interesting test was carried out with the 12-inch polar telescope, when 19 experienced observers had the unique opportunity of observing the same variable star, *SS* Cygni, under like conditions. In their recorded estimations of brightness it was found upon comparison that the average deviation between observers was only 0.14 magnitude.

The Current Supplement

THERE are many problems of geology that have not been definitely settled, and among them volcanoes occupy an interesting position. Readers of the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2143, for January 27, 1917, will undoubtedly welcome *A Theory of Terrestrial Volcanoes* that appears in this number. The neighborhood of Rome is an inexhaustible storehouse for the archæologist and students of art and architecture, and, fortunately, the Italian government appreciates the conditions, for it is almost constantly prosecuting excavations that result in discoveries of absorbing interest to the entire world. The article on *New Excavations on the Palatine* in the current issue, written by Prof. Boni, who is in charge of the work, describes many important remains that have recently been brought to light and gives many valuable comments. The article is profusely illustrated by photographs taken in the immediate vicinity. Although something was previously known about the toxic effects of trinitrotoluol, the results due to the handling of the immense amounts of this powerful explosive that have been required for purposes of the war have directed special attention to the subject. The article on *Trinitrotoluol Poisoning* is an official communication by the Ministry of Munitions of Great Britain which covers the subject quite fully, including the nature of the material, toxic symptoms, preventive measures and treatment. *A Modern Cargo Vessel* describes and illustrates one of the recent additions to our merchant marine, and shows what sort of work is being turned out by American yards, not only for our own service but for many foreign owners as well. *Old English Weathervanes* tells of some curious ornaments to be seen on old buildings in England, and it is illustrated by a number of sketches. It is a very readable article. *A New Condensation Hygrometer* describes and illustrates a scientific instrument of considerable value, and also some preceding forms devised for accurate investigation. *A Simple Carburetor* is a suggestion of the desirability of more simple devices, and is accompanied by a diagram. The second lecture on *Vibrations, Waves and Resonance* appears in this issue. Other interesting subjects are *A New Cipher Code, On Volume in Biology* and *Bacterial Retting for Ramie, Flax, etc.*

A Week's Review of the War, January 19th, 1917

By Our Military Expert

NO review of the military happenings of the past few days would be complete without taking into consideration the reply of the Entente Allies to President Wilson's note asking both sides to state the terms of peace that they would propose. This the German government promptly declined to do, but issued, on the same day that the Allies made known their terms, a very vague and apparently a not well-considered note, consisting largely of accusations and recriminations. On the contrary, the Entente answer to the President's query was a clear and definite statement of their views and aims in this titanic struggle of nations. Their peace terms can be summarized as follows:

1. The restoration of Belgium, Serbia and Montenegro, with indemnities.
2. The evacuation of the invaded territories of France, Russia and Rumania, with reparation.
3. The reorganization of Europe with guarantees to insure to all nations respect and liberty of development.
4. The restitution of territories taken in the past by force or against their peoples' will.
5. The liberation of Italians, Slavs, Rumanians and Tcheco-Slovaks from foreign domination.
6. The freeing of populations subject to the Turks.
7. Expulsion from Europe of the Ottoman Empire.

The demands under the fourth heading refer, of course, to the question of the recession of Schleswig and Holstein to Denmark, from which country they were taken after the war of 1864; also to the return to France of Alsace and Lorraine.

The fifth demand has reference to the cession to Italy of all the parts of Italian-Austria now known as Italia Irredenta, which includes also all of Austria bordering on the Adriatic; also the cession of Transylvania to Rumania and the practical freeing of all the Balkan countries.

Armenia is naturally referred to in the sixth demand; one result of this war, no matter what else may happen, will undoubtedly be the acquirement by Russia of that unhappy country.

Where the Turk would go under the decision of the Powers is a great question; but once Constantinople is surrended to Russia, or, with its surrounding country becomes a neutralized state, the only natural refuge for this Oriental Power would be Asia Minor with Broussa possibly as a seat of government.

Russia has already stated what her intentions are as regards Poland; the Entente Allies in their note take great pains to say too that it has never been their design—"to encompass the extermination of the German people and their political disappearance." The note, however, makes some singular omissions; it will be observed that nothing is said as to the future fate of the German colonies scattered over the world and held now by the Allied nations in their entirety, except small parts of German East Africa in which fighting is still going on. Is it to be imagined for a moment that Japan would consent to give back to Germany Kiao-Chau for which she has given both blood and treasure? And will the Cape and other British colonists in Africa consent to return to Germany the lands won by them by force of arms with little or no assistance from the mother country?

These are all serious questions brought up by the Allies' demands. The Allied note is a diplomatic document that will undoubtedly make much history in the future.

Certainly one fact is clear—that there is no intention on the part of the Entente to allow the fulfillment of Germany's dream—a great central European empire that will stretch with its dependencies from the Baltic across Central Europe and Turkey in Asia to Bagdad and the Persian Gulf.

This leads to the consideration of one military movement brought out during the past few days that may have far-reaching consequences, viz:—the fighting in the Sinai Peninsula between the British forces and the Turks, with the reported defeat and rout of the latter. The British are now reported at El Arish and Raphia within ninety miles of Jerusalem on the one hand and of the Damascus-Medina-Mecca Railway on the other. If this railroad is cut at any point, all Turkish troops to the south will be at once neutralized, especially in view of the rebellion in the Hedjaz against Turkish domination. If El Arish and its neighborhood is now in British hands, it will be but a short time when, with the aid of the fleet, Joppa, the port of Jerusalem, will be in their possession. The Holy City itself must then fall to British arms. What the political effect of such a capture would be upon the Oriental mind can well be imagined.

Beyond these eventualities, are suggested an advance along the Mediterranean coats to Beirut with the consequent cutting of rail communication to Damascus, a forward movement to Adana to join hands with the Russians pushing southwest from Erzerum and an attempt from this direction by both forces toward Constantinople. A suggestion has also been made of a possible advance toward Aleppo and the Euphrates River—where all communications between Turkey and the forces operating in the defence of Bagdad could be destroyed, thus rendering much more easy the task of the British armies now operating on the lower Tigris in Mesopotamia against the same city. All these military feats would read like a story from the Arabian Nights; but equally strange things have happened in this war.

The heaviest fighting, outside of the Rumanian advance of the German forces, has been on the extreme northern end of the Russian lines between Riga and Mitau. The Russian lines here begin at a point on the Baltic coast some distance to the west of the mouth of the Dvina River and run in a southeasterly direction across the Great Tirul marsh near Mitau to Dvinsk and thence to the south in a zigzag to Pinsk, the Pinsk marshes and beyond. As the inaccessible marshy ground between Riga and Mitau is now frozen over, military movements are possible that would not be so at any other time. The object of the struggle now going on there is undoubtedly the possession of Mitau, which has been made by the Germans a great storage depot for the supply in all directions of their forces on the general Riga front. The roads radiating from Mitau render such distribution easy and constant; the loss of this town would seriously compromise the safety and supply of a good part of the German lines over a considerable area in that vicinity.

The desperate struggle in Rumania between the Teuton forces of Mackensen on the one hand and the Russians and Rumanians on the other, continues along the Sereth, its tributaries and into Moldavia. This fighting has been particularly violent along the eastern slopes of the mountains leading to the valley of the Sereth; so far the advantage seems to be on the side of the Germans. But their progress has been at great expense in men and supplies, and it would seem to be a question how soon it will become necessary to suspend operations, especially as the bad weather so greatly hampers all military movements. It is evident too that Germany has no desire to extend her lines of communication any more than necessary, and the banks of the Sereth will no doubt see her forces at a standstill, especially as the resistance of the Russo-Rumanian armies has stiffened so greatly within the last few days.

The movements of the Saloniki armies have been most restricted of late, due, no doubt, to bad weather and lack of roads. The positions on the Vardar have been bombarded and some shelling around Lake Ochrida near Monastir has also taken place. But the object of this great army's movements will never be obtained until the railroad from Belgrade to Constantinople is cut at Nish or Sofia; and so far but little progress to that great end has been made. Once real safety is assured for its base by radical steps at Athens and with the Greek army, spring should see a general advance of Sarrail's force to the north and substantial progress made toward its goal, with a possible successful issue.

On the western fronts, trench raids and intermittent fighting and shelling on each side have taken place. As usual, bad weather has seriously interfered with military operations, and but little can be expected in that way until the sun and warmth of spring have dried out the everlasting sticky mud of northern France and of Belgium. Of this mud much has been written, though no pen can ever do it entire justice.

Great preparations for the spring advance are undoubtedly going on on all sides. Sixty divisions or 1,200,000 more men are to be put upon the firing lines by the Allies, if newspaper correspondents can be believed. As one of them states—"The necessary men exist and there is every probability that their appearance in the field will decide the war." Germany is reported to have 128 divisions or 2,560,000 men on the western front; so that a far greater number on the part of the Allies must be on hand if a successful advance is to be assured.

The appearance of so many young boys of the classes of 1917 and 1918 among German prisoners taken by the Entente would indicate the serious shortage in men of proper fighting age which is now being felt among the Central Allies; such a shortage must constantly increase as the war goes on.

English munition factories are now being pushed to their utmost and are said to be turning out more heavy gun ammunition every forty-eight hours than they manufactured in the entire first year of the war; this production is reported to be increasing week by week. In one week, it is stated, the shell of all kinds completed exceeded by thirty per cent the entire stock of munitions held in reserve at the outbreak of the war. The increase in the manufacture of explosives is said to be enormous. For every ton of explosives employed in September, 1914, 350 tons were employed in July, 1915, and 12,000 tons in July, 1916.

This data will give some little idea of what one nation is doing in preparation for the spring advance; others are probably doing equally as much. The struggle will be a frightful one, with the loss of thousands of lives and consequent suffering to many thousands more of innocent women and children. Everyone should sincerely hope that this year may see the end of this and of all wars and for all time.

Ethno-Chemistry

THE differences among races in such physiological and anatomical details as height, build, color, texture of skin and hair are obvious to the most careless eye. We have learned too that these differences are supplemented by certain psychological differences. Now comes the theory, not only highly plausible but already backed up by a certain amount of proof, that there are equally marked chemical differences. Thus Ehrlich found that the number of white blood corpuscles among Germans averaged 4,570,000 per cubic millimeter while the French investigator Hayem counted 5,500,000 to the cubic millimeter in French blood.

The subject is so new and the minute observations it entails demand so much time and labor that much remains to be done. There should be a close and systematic comparative study of the various races, with reference to the viscosity of the blood, the proportion of salts in the various tissues, the absorption of fats, the constitution of tissues, humors, glandular secretions and excretions, the density of organs, and the strength of various reactions.

The correlation of the results of such studies might explain the immunity of certain races to certain maladies, and even indicate the best prophylactic methods to employ against them. Furthermore, it is possible that we may find in this new science a subtle reason, literally blood of our blood, and bone of our bone, for the instinctive racial antipathies which have been so manifest in every age of the world. Here, too, we may have a reason for the persistence in various peoples of peculiar instincts, impulses, tendencies, needs and appetites in spite of the efforts of religious or political organizations to modify these traits in individuals or groups.

An enthusiast upon this somewhat recondite subject, Dr. Berillon, writing in the *Monde Latine* goes even further. He suggests that ethno-chemistry will permit us to comprehend why divers races exhibit different mental and psychological reactions in the presence of identical stimuli.

He observes, too, that this new science may enable us to determine which races stand highest in the scale, considered merely as capable and intelligent animals. Such determination of ethnic value would have a direct bearing on the restriction of immigration of certain races and on marriage laws.

Another of Dr. Berillon's suggestions is that we ought to be able to establish the cause of irremediable antagonisms between hostile races, since he finds "psychological and social affinity incapable of manifestation where chemical affinity does not exist." He finds himself forced to believe that all the individuals of any species among which the herd instinct is strong (and this of course includes most varieties of homo sapiens) possess an absolutely identical chemical isomerism, as a consequence of which they emit an identical odor. The fact that the odors characteristic of certain races are highly repugnant to other races has of course been observed, just as has a similar aversion by some kinds of animals for the scent of others; but Dr. Berillon would have us recognize in this fact a fundamental importance never before attributed to it.

Age of Egg Laying House Flies

ONE feature of the fly killing campaign has been the emphasis laid upon the destruction of flies in the spring as a means of reducing the succeeding generations. This method of control proceeds from the assumption that a rather long period elapses between the emergence of the adult fly and the first deposition of eggs (the so-called "preoviposition" period). This assumption, which had been based upon rather meager data of observation, has been tested by a series of investigations carried on by Mr. R. H. Hutchinson and collaborators. Flies kept in cages were used, and the following results were obtained: The shortest record for the period preceding oviposition was about 2½ days; the usual length was from four to five days. Temperature had a very decided influence on the length of the period, while humidity, and the kind and quality of food of both larvæ and adults also influenced its length. The average length of life of some 3,000 flies was slightly over 19 days, the Methuselah of those observed being an individual that attained the ripe age of 70 days.

A Storehouse of Sleeping Energy

The Unique Chemical Advantage Which Acetylene Possesses Over Other Fuels

By J. M. Morehead

ACETYLENE is unique among chemical substances. It is in a class by itself among fuels and industrial gases. There is no other industrial substance approximately like it in its physical and chemical characteristics or in its behavior, and it has, therefore, to be produced, handled, transported, stored and used according to rules of its own.

All of these differences and 95 per cent of its value for light and for heat depend upon one quality, which acetylene alone among industrial substances possesses, and which sets it apart. This property can be expressed in one term "Endothermic Energy."

When any two or more chemical elements unite to form a compound, the union is always attended with either an absorption or a generation of heat, and when the substance is burned its combustion will always give either more or less heat than could be obtained by burning its uncombined elements.

The overwhelming majority of chemical combinations are attended with the generation of heat, and the substances when burned, consequently give less heat than could be obtained by burning, in a state of purity, the elements forming the substance. These, which give off heat upon their formation and require heat for their dissociation, which evolve less heat than the sum of the heat of their elements, are known as exothermic bodies. A few of the thousands of common exothermic substances, with the difference in British thermal units between the heat of the combination and the sum of the heats of the separate elements, are:

	B.t.u.
Acetone	+281
Grain Alcohol	+280
Carbon Monoxide	+138
Ethane	+137
Methane	+104
Hydrogen Sulphide	+ 14
Naphthalene	+ 11

But there are a few substances in nature in which these conditions are reversed; that is to say, they absorb heat upon combination and give off excess heat upon decomposition. They require varying amounts of heat to drive them into combination, and they give off this heat or energy when they dissociate. In other words, the combination will give more heat when burned than could be obtained by burning the elements separately. Such bodies are known as endothermic bodies, and the excess heat is known as endothermic energy.

In ordinary chemistry the number of endothermic substances is limited to not more than one dozen. Several of these, along with the B.t.u. necessary to make them combine and the heat given off when they dissociate, are:

	B.t.u.
Cyanogen	−314
Acetylene	−227
Carbon Bisulphide	−124
Benzine	− 59
Toluene	− 17
Ethylene	− 13

From this it will be noted that, except for the deadly poison cyanogen, which probably does not exist in a state of uncombined purity, acetylene has more endothermic energy than any other known substance. A cubic foot of acetylene when burned gives 227 heat units more than can be obtained by burning a weight of carbon and hydrogen equal to the respective weights of these two elements contained in the acetylene. In other words, this gas contains not only carbon and hydrogen which can be burned to produce heat, but it has them so combined that by merely breaking them apart they will give up or produce heat. Under certain conditions this heat can be produced or liberated without any burning at all.

The possession of endothermic energy is the property which distinguishes acetylene among gases and gives it its preëminence. It is responsible for its extreme candle-power, for its high heat unit content, for its low ignition temperature, for its high-flame temperature, for its economy when used in connection with oxygen and for the method of storing and shipping now universally employed. Upon the possession of this endothermic energy rests its immunity against competition from other fuels or sources of heat. On the other hand, it is the cause of the explosibility of unabsorbed acetylene when compressed, and it is the one bar which keeps acetylene from being extensively used for power purposes.

Candle-Power

When any hydrocarbon is burned for the purpose of producing luminous flame, some ninety-eight per cent of the substance is consumed in heating to incandescence the carbon particles of the other two per cent. The consumption of the ninety-eight per cent results in the formation of products of combustion—mixed with a large excess of nitrogen—which dilute the gas, expand the flame, lower the temperature and detract from the incandescence of these particles, and hence from the candle-power of the flame.

In an acetylene flame 227 B.t.u. out of 1475 are produced without any combustion or formation of products of combustion. When the carbon particle is freed from its combination with hydrogen, there is released at the same instant endothermic energy which raises this carbon particle to vivid incandescence and produces the highest known open-flame candle-power—240 for acetylene as compared with 40 candle for Pintsch gas, 20 for water gas, 16 for coal gas and 4 for natural gas.

Calorific Value

Added to the heat which can be produced by the consumption of its elements, acetylene has an extra heat producing capacity in its endothermic energy, which added to the other heat raises acetylene to a position near the top of the list of industrial gases when they are arranged according to their heat unit content, acetylene possessing a total of 1475 B.t.u. against 1275 for Pintsch gas, 1000 for natural gas, 550 to 650 for coal and water gas, and 325 for hydrogen.

Ignition Temperature

A substance surcharged with energy is naturally more unstable than one requiring heat to break it up, and by reason of its endothermic energy acetylene is more unstable than other gases. This shows itself in a low ignition or kindling temperature, and makes the gas particularly well adapted to use with lighters of the friction, electric, or spark type, with which a large majority of the modern acetylene fixtures and miners' lamps are equipped. The advantage of acetylene in this respect are indicated by the following figures, which represent ignition temperatures on the Fahrenheit scale, first in air and second in oxygen: for methane, 1,292 degrees and 1,162 degrees; for carbon nonoxide, 1,204 degrees and 1,202 degrees; for hydrogen, 1,085 degrees in both media; for ethylene, 1,009 degrees and 950 degrees; for acetylene, 804 degrees and 782 degrees.

Flame Temperature

Knowing the heat to be liberated by the combustion of any substance, together with the quantities and the specific heats of its products of combustion, it is a simple calculation to determine the temperature of the flame produced by the burning of this substance. In a general way it may be said that the temperature of any flame depends upon the difference between the total heat produced by the combustion, and that absorbed by the products of combustion. Now if any fuel can produce a large amount of heat with zero products of combustion, its flame temperature must manifestly be extraordinarily high. Such is the case with acetylene and those 227 B.t.u. of endothermic energy liberated without any products of the combustion of the carbon and hydrogen which make up the gas. On account of this property it stands at the very apex of temperature producers, and when acetylene is burned with oxygen it produces a temperature which is recognized by chemistry as being the very acme possible by combustion of any fuel. The following table shows the figures in degrees Fahrenheit:

THEORETICAL FLAME TEMPERATURE

	With Air	With Oxygen
Acetylene	4078	7878
Pintsch Gas	3597	6785
Hydrogen	3906	6710
Carburetted Water Gas	3590	6580
Coal Gas	3570	6575
Natural Gas	3460	6490
Alcohol	3516	6324
Carbon monoxide	3634	5886
Gasoline	3503	5788

Economy

When it comes to buying heat units acetylene is not an economical form of fuel. A dollar invested in natural gas, city gas, gasoline or kerosene will procure much more heating value than would the same amount invested in acetylene. To get the heat from these fuels, however, for cutting or welding, oxygen must be provided for combination with every atom of carbon and hydrogen entering into their formation. As oxygen is the expensive element in oxy-blowpipe work, this requirement on the part of the ordinary fuels makes their use unduly expensive. When acetylene is used the endothermic heat is liberated without the consumption of any oxygen, and hence when used in competition with other forms of fuel the extra expenditure for oxygen more than counterbalances the saving on gas, and the net result is considerably in favor of acetylene.

Storage

Acetylene can readily be compressed to its liquefaction point and might be stored, distributed and used thus were it not for its endothermic energy. Having so much energy, loosely held, acetylene becomes explosive when the pressure exceeds some 15 to 20 pounds to the square inch. Its explosibility does not depend upon or require the presence of air or oxygen; the energy of unabsorbed compressed acetylene can be released by heat, flame, detonation or violent concussion. The violence of the resulting explosion may be inferred from the fact that under very ordinary conditions liquefied acetylene stored in steel tanks may develop pressures as high as 50 tons per square inch. To overcome this and remove the explosive hazard inherent in unabsorbed acetylene under pressure, the process was devised of absorption and storage in acetone, which in its turn finally is absorbed in asbestos.

Explosiveness

The endothermic energy of acetylene gives to this body its explosive qualities and is responsible for practically all of the accidents which have occurred when ignorant or misguided people have experimented with this gas under pressures in excess of 15 pounds.

When different gases are mixed with the proper amount of air for complete combustion, equal volumes are practically of equal calorific value. That is to say, one cubic foot of a mixture of acetylene and its proper proportion of air, of natural gas and its proper proportion of air, or of coal gas and its proper proportion of air, will have about the same number of B.t.u., irrespective of the heat units in the gas and despite the fact that acetylene has twice the heat of coal gas and half as much again as natural gas.

The reason for this is that the richer the gas the more air it requires for complete combustion. Hence a cubic foot of the mixture of a rich gas contains more air and less fuel than is the case with a leaner gas.

It is fairly safe to say that a cubic foot of any ordinary gas, with its proper proportion of air for complete combustion, will have within fifteen per cent one way or the other of 100 B.t.u. A cubic foot of free acetylene without any admixture of air, if unabsorbed and compressed to beyond 15 pounds, has an explosive value of 227 B.t.u. Hence the explosibility of unabsorbed acetylene at a pressure in excess of 15 pounds is some two and one-half times as great as that of the same acetylene, or of any other fuel gas, if properly mixed with air. In other words, an explosion of unabsorbed compressed acetylene has, by virtue of its endothermic energy, more than twice as much force as any ordinary gas explosion due to the burning or exploding of gas and air.

Acetylene is always transported, stored and used either absorbed in acetone, or at a pressure of less than 15 pounds per square inch. Under neither of these conditions does it possess explosive properties, *per se*, but like other gases it requires air or oxygen to make it burn. Its use in industry or in the arts may thus be made neither more nor less hazardous than the use of other combustible gases or liquids.

Power Purposes

Its endothermic energy also makes the ignition temperature of acetylene low, thus preventing high compression in an engine cylinder. This in turn detracts from the efficiency of the engine and bars the economical use of this gas for power purposes.

As compared with all other industrial substances acetylene occupies a position at the top of the list for light and heat. To get a substance which would compete with acetylene in its present field it would be necessary to get one with a higher endothermic energy content. Through well known laws of chemistry it is recognized as impossible to obtain such a substance by any combination of carbon and hydrogen.

Acetylene obtains its eminence by standing upon its endothermic energy. It gets an immunity from competition by intrenching itself behind its endothermic content and we feel that, grounded upon the unchangeable laws of nature, our product is safe in its place of chemical and physical superiority, and secure from the industrial competition of all other substances purporting to do the same work.

The above paper was read by Mr. Morehead at a recent meeting of the International Acetylene Association.

The "Comfortimeter"

THE U. S. Hygienic Laboratory has continued its studies, previously mentioned in these columns, with a view to developing apparatus for testing air with respect to human comfort, as dependent upon temperature, humidity and wind movement. The "comfortimeter," as now designed, is said to fulfil all practical requirements, and the final work of calibrating it against the actual comfort of individuals is in progress.

Economic Conditions In Germany—II

A Great National Bread Trust

By Albert K. Dawson

Photographs copyrighted by Brown and Dawson

"YOUR bread card please," says the waiter and at the same time deftly withdraws the plate of bread for which I am reaching. "All right," I say, "In a minute; let's have one of those rolls." "Card first," says he and moves the plate still farther back. Then follows a search which usually ends in my finding that I have left my bread card at home or in my other coat. This I explain at length, but to no avail. The waiters cannot be coaxed, frightened or bribed. Like the Chinaman who says, "No tickie, no washee," they stand firm on the rule, "No ticket, no bread."

When relations with the determined waiter reach the point where the average American feels like taking the matter up with our Ambassador, it usually follows that the portly German across the table interrupts with "Pardon, mein Herr, but I see you are an American and do not understand our system. May I put my card at your disposal?" And with a courtly gesture, like one offering another a cigarette, he hands his card across the table. I have gone through this performance not once, but dozens of times, and I have found that, if I argue long enough and loud enough, some one will always come around and offer me his bread card. From this the waiter detaches one of the 25-gram checks for which he then gives me one roll or one slice of bread.

Such are the workings of the German food system; there is enough for everyone and to insure each one's getting his share the card system is used. The price is fixed by law and the amount any one person can buy at one time is limited to his immediate need, thus making speculation out of the question.

"Can Germany produce enough bread for her own needs?" I asked Director Hugo Meyer head of the German Bread Trust. "Judge for yourself," he replied, "here are the official figures on our imports and exports of grain and grain products covering the period of ten years immediately before the war.

"These figures show a constant increase of exports over imports till, in 1913, the exports showed over 2,000,000 tons excess over imports. In other words Germany produced two million tons more than she used herself. Therefore, the problem is only one of regulation and distribution. Of late years Germany has become a white-bread-eating nation. She produces a great deal of rye in her own borders which she does not eat, but exports to Russia and imports American and Russian wheat instead. The war has obliged us to return to the black bread of simpler days, but the quantity remains the same.

"As bread is now a national monopoly and there is no longer any competition in buying, what measures do you take to make the farmers plant the necessary acreage?" I next asked. "Very simple; we pay the farmer a price that makes farming very profitable. Our war-time price is about 10 per cent higher than the average price of 1913."

This German Bread Trust, or Reichs-Getreidestelle, is an unusual orgnization. Its board of directors is composed of the best commercial, legal and financial brains of the empire, men whose names are known in commercial circles all over the world. They are Dr. K. Cuno of the German Treasury Department; Herr Koepke, Deutsches Bank of Bremen; Dr. Oppenheimer, commercial lawyer; J. Goerg, a large landed proprietor; Gustav Scipio, a big importer of Bremen. At the head of this organization is Hugo Meyer, in peace times the manager of the "Getreide Commission A. G." of Dusseldorf, the largest grain importing concern on the continent. Herr Meyer is a fine type of the modern German business man, keen and business-like, but without the ostentation of the old school. He is an organizer, and to him is due the credit for the bread-card idea.

This bread trust, which has been described as the biggest corner on grain since the days of Pharaoh, has its main office in Berlin. Its work consists in buying the grain from the producer and distributing it to the various cities and communities. About 1,000 clerks handle the clerical work, assisted by all sorts of tabulating machines and labor-saving devices. Through a system of perforated cards the statistics department checks all payments daily. They use the same machines and card system which were used in Washington, D. C., in checking up our last census. A little over one million bushels of grain pass through the hands of the Bread Trust each day.

The system of buying is as follows: The country is divided into districts, depending on the average quality of the grain it produces. A standard price is set for each district. All grain coming up to standard receives the maximum price. Grain falling below is judged and paid accordingly. Grain must be sound, dry and of average quality. The field representatives take two samples from each car of grain bought. One sample goes in a sack and another in a corked bottle to the Berlin office. Here the sack sample is judged for soundness and quality by direct inspection, and the bottle sample goes to the research laboratory to be tested for dampness. Grain is accepted as standard if the moisture does not exceed 19 per cent.

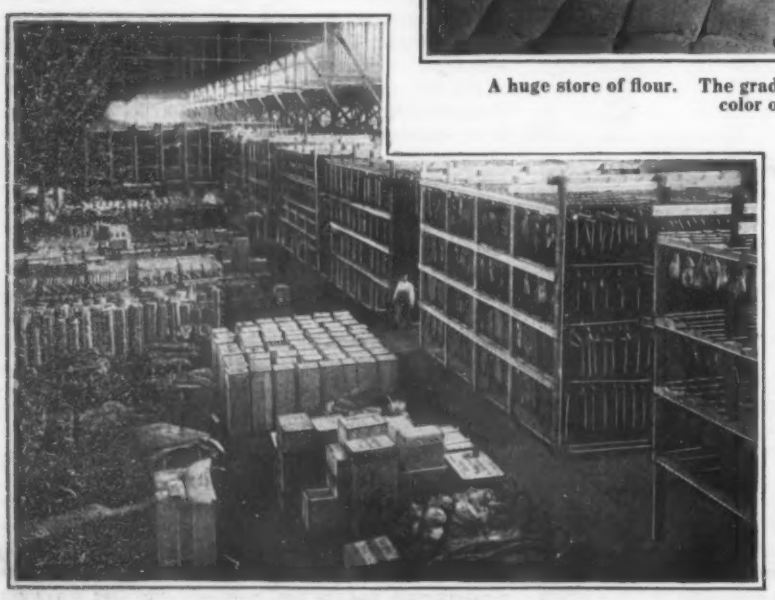
In case a producer does not agree with the findings of the inspectors he can take his case before the judges. They consist of 12 farmers from the Land Wirtschafts Kammer, 12 merchants from the Handels Kammer (formerly grain buyers) and one judge from the civil courts. Three of the farmers, three of the merchants and the judge sit at a time and hear cases for a day as a combination judge and jury. From their decision there is no appeal.

I asked one of these judges, a merchant, if there was any likelihood of this bread trust continuing after the war, as it seemed to work so nicely now. "Not a chance in the world," he replied. "As soon as the war is over competition will start up again, and those of us who have worked here together for the common good will fight each other harder than ever."

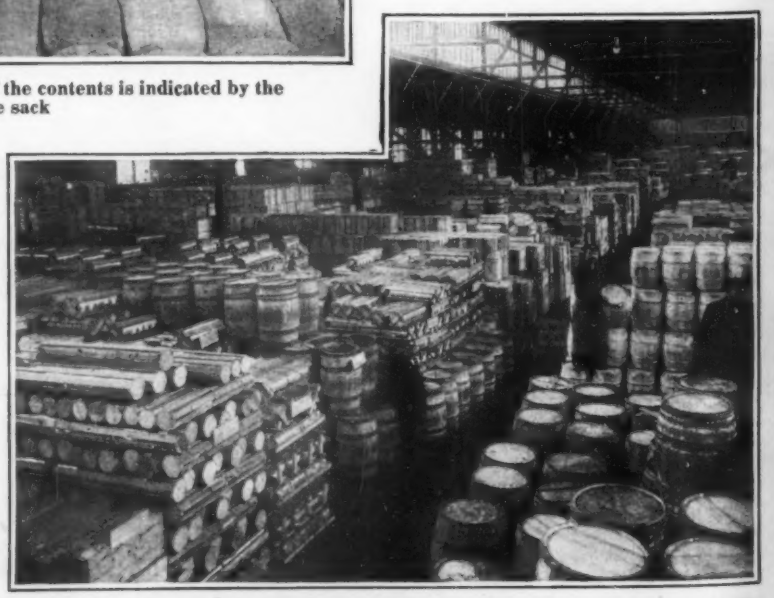
Each town or community mills its own grain when received from the Reichs-Getreidestelle. The flour is then divided among the bakers, selling to them at a

Storeroom of a field bakery. Each loaf served the soldiers is stamped with date of baking

A huge store of flour. The grade of the contents is indicated by the color of the sack



Reserve provisions stored in Hamburg



Dry groceries in Hamburg stores

fixed price; and the bakers, after converting it into bread, must again sell to the public at a fixed price and collect the bread cards from their customers as well. The baker can get more flour only by turning in these bread cards to show that the first lot has actually been disposed of. The quality of the bread varies in different cities, in some places it is darker than others or contains more potato meal. Flour will not be sold to a housewife under any circumstances.

Each city issues its own bread cards, the amount is the same, 250 grams per day per person. This is a little over half a pound.

I found this more than sufficient for my need as I never used an entire card in one day. The old card with the unused stubs must be turned in before a new one will be issued. The only place where bread may be had without a card is in a railroad restaurant or a dining car.

The bread of the soldiers is hard, black and sour. Not at all like the bread we are used to. It is coarse in texture and very solid, but withall wholesome. I lived on it myself for several months and gained weight; but when I did get hold of a loaf of white bread, by chance in a Servian village, it tasted like cake to me. The officers eat the same coarse bread as the men. Each German soldier receives a loaf of this "War Bread" a day. It weighs a little over a pound. Every loaf has the date pressed into the top, so that the man will know at once if he is not getting fresh bread.

It is seldom that the soldier eats the full amount, but I never saw one throw any away. He either feeds it to his horse or gives it to the local population. In northern France and Belgium I have seen thousands of children lined up along the railroad embankments where the troop transports go by, each holding up his little hand and begging "Bitte, stuck brot" (please a piece of bread). It is remarkable how quickly these children pick up German. And the soldier breaks his loaf in two and throws the half out of the window. Whatever the policy of the leaders may be, I have always found the common soldiers of Germany generous and tender hearted. When I ask them why they throw their bread to the children, keeping the small half for themselves, more often than not they justify themselves by saying, "I have children of my own at home."

The baking for the army is done in field ovens, large cylinders which look like steam boilers mounted on wheels with firebox beneath. These are easily transported and keep just behind the front to send fresh bread up to the men in the firing line.

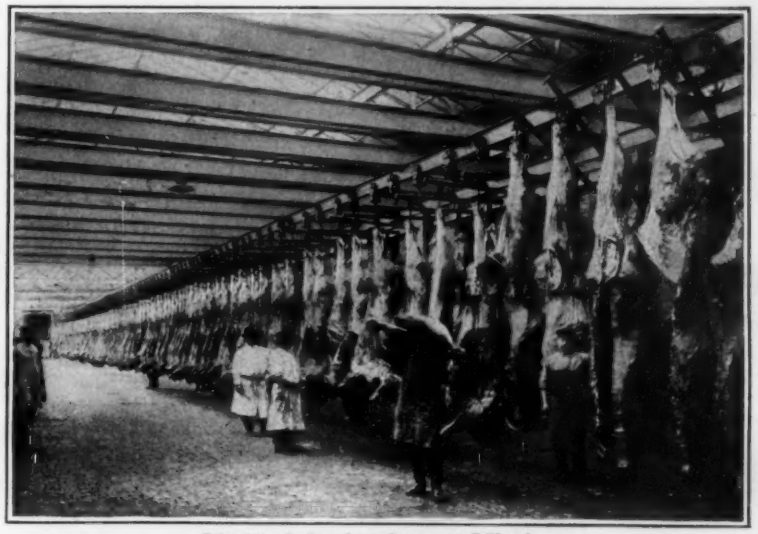
Feeding the three million prisoners of war is no light task for Germany. She aims to give them a well-balanced ration which will keep them in sound health; but she cannot in the nature of things cook to suit the individual tastes of the many nations from which her prisoners are drawn. Thus, we seldom find a prisoner satisfied with his food. I personally have eaten the rations served in many prisons, and while it is not such as I am accustomed to at home, it is as a rule as good as, and in some cases better than what I received while in the field with the German, Austrian and Bulgarian armies. The prison food is well cooked, and is served at regular intervals; the soldier ration is not so well cooked and is sometimes served at decidedly irregular intervals. The prisoners are allowed to receive anything in the shape of eatables home folk will send them and the packages of food which come into Germany in this way are no small item.

Packages of food amounting to hundreds of tons come in from England, France and Russia for the prisoners each month.

I have thought sometimes, in reading in the American papers the stories of the terrible food the prisoners receive that this was perhaps a clever ruse of the Germans to increase the package business, for I have not found this food so bad. Of course every pound of food so received is a pound saved for Germany.

The meat supply of Germany is now being handled on much the same lines as the bread, namely by tickets. This step has only been taken of recent date, but it would doubtless have been a great advantage had it gone into force long ago.

At the beginning of the war, as a measure of precaution, the German government required every city of more than five thousand to put away in storage meat in some form to the value of eleven marks per head of population. This means that there is a reserve supply of meat stored away amounting to about thirteen pounds for every person in Germany. (About eighty-five per cent of the population lives in cities of over 5,000 and at the time these supplies were laid in 11 marks would buy fifteen or sixteen pounds of meat). This fact is not generally known even to the mass of the Germans. I have never seen it published in any of their newspapers. The government has probably passed out word to the censor to keep it quiet so as not to cause public discontent. The above figures were given me by one of the men who is in the Central Department, which did most of the buying for the cities. Furthermore, this tremendous reserve was all bought outside of Germany, so as not to disturb the home market. In order to convince me of these facts, he gave me letters which allowed me to visit the great warehouses and cold-storage plants of the principal cities, where I could see for myself. I did not have time to visit them all; but the amount of meat I saw in storage was beyond belief. It comes in every form: Salted, smoked, dried, canned, pickled and frozen. One single cold-storage plant just outside of Berlin contained 6,000,000 pounds of frozen meat which had been in storage since October, 1914.



Municipal slaughter house at Lübeck

Zur gefl. Kenntnisnahme
Gegen Abgabe einer Brotmarke ist Schwarz- oder Weißbrot für 5 Pf. beim Kellner erhältlich.
Eine Düte Weißbrot 75 Gramm
Eine Düte Schwarzbrot 50 Gramm

General notice found in all Germany's restaurants: "Upon presentation of a bread ticket, black or white bread is to be had from the waiter for five pfennings"

Bread card, good only in Berlin and suburbs, and only for the date filled in upon the dotted lines

Marketing in Berlin. Game is cheaper than poultry

Then a turn through the salt meat department showed me sides of pork piled up like cord wood, and into the smoked meat shed, where I saw hams and bacon enough for an army hung in orderly rows in racks.

In Lübeck I found much the same store of provisions in reserve as in Hamburg, and, in addition the municipal slaughter house was butchering cattle at the rate of several thousand a day and putting the meat in storage for the use of the army. This meat came on the hoof from the northern countries,—Norway, Sweden and Denmark. Lübeck is a very convenient port for its entry.

It is hardly necessary to speak of the meatless days, as they are so well known by this time. At the beginning this was quite a hardship on the heavy-eating Germans, although everyone I met put on a brave face and declared they did not mind a bit. Whatever a German's real feelings may be, he always tries to put up a fine front before the "Auslander." It is a fact that some of them lost weight under this new régime; but many of them could lose more and be the better for it.

Early in the war the authorities showed their appreciation of the power of advertising by posting in street cars and other public places notices reading like this:

Boil your potatoes with the jackets on. To peel them first is very wasteful.
Eat less meat and more fresh fruit; the meat we can save while the fruit will not keep.
Do not cut a fresh loaf of bread till every scrap and crust of the other is used up.
Do not fry your food; it uses up lard, which is scarce, and fried food is not healthful.
Eat more soups; in soup nothing is wasted.
Preserve all the fruit you can in summer, while it is cheap, you will need it later.

By local ordinance every householder is required to separate the garbage put out for the collector. Everything which might be used for horse or cow feed must be put aside, drained dry and wrapped in a clean paper. This includes all fruit and vegetable scraps, the tops and the parings. Anyone failing to observe this rule is fined.

The food question has its comic as well as its serious side. At the beginning of the war many people got the panic, rushed out and bought all sorts of supplies in wholesale quantities. One gentleman told me how his wife got this fever and among other things purchased 600 boxes of matches, enough, he had figured at their present rate of consumption of nine matches a day, to last 26 years.

The Aeroplane as a Destroyer of Enemy Observation Balloons

IT is now a matter of history that the German Army at the outset of the present war was prodigiously supplied with observation or kite balloons. Correspondents at the front in those days continually referred to the German *drachen* or sausage balloons which floated over the German lines in comparative security, and which kept their commanders informed as to the activities in back of the Allied lines, while the Allies in turn were without similar equipment or facilities.

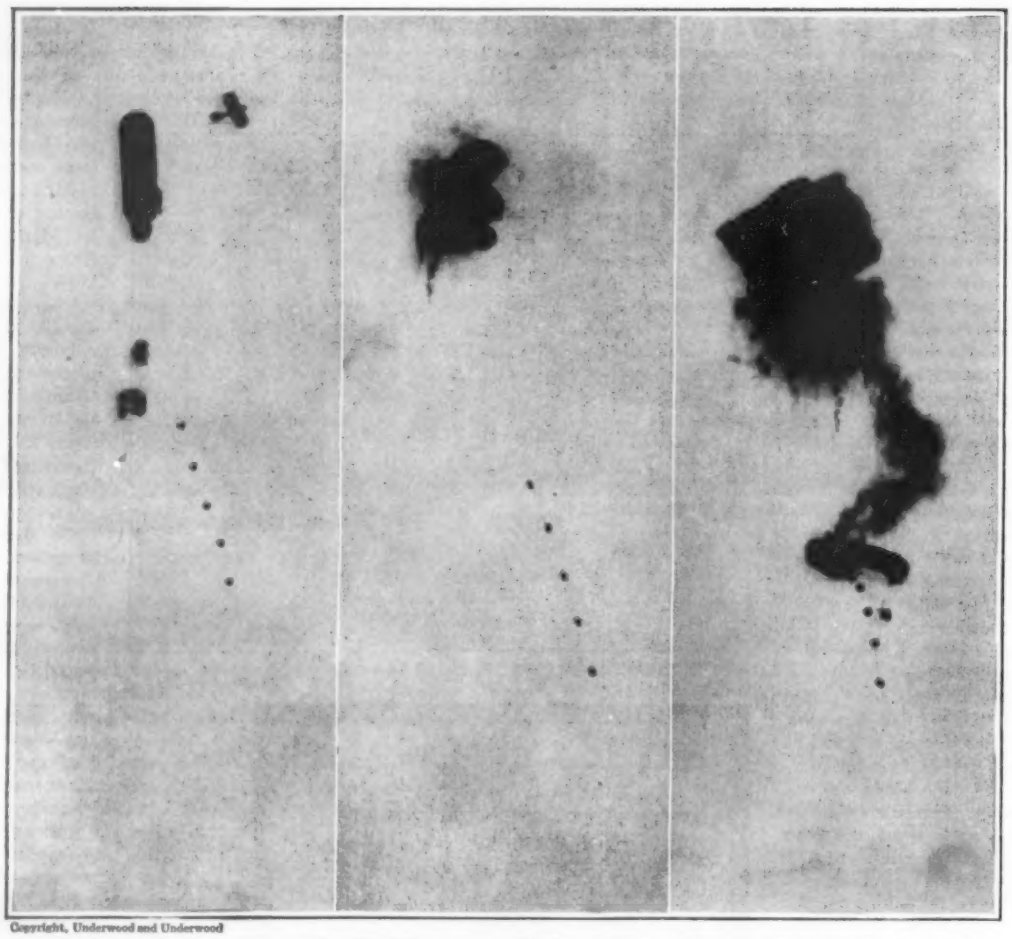
Imagine an enemy who is fully informed of the slightest movement on your part and who can liberally spray any of your positions with the most accurate artillery fire, while you are in total ignorance of the conditions back of his line and must aim your guns more or less by instinct, or at best by the map, and you have the approximate condition in which the French Army found itself during the later part of 1914. So it was that the French were spurred in their work of not only building a fleet of observation balloons, but of devising suitable means for the destruction of enemy balloons. It was just before the battle of Champagne in 1915 that the French developed an aeroplane mounting a 1½-inch quick-firing gun firing an explosive shell, which was used successfully against a German observation balloon. The result of the destruction of this German *drachen* was far-reaching with the Teutons, for it made them more cautious in running up their balloons. Shortly afterwards the rocket system was developed, whereby an aeroplane was equipped with a number of rockets mounted in parallel rows and fired singly by pushing an electric button, the whole machine being brought to bear on the target. So successfully did this system prove that during the battle of the Somme it has been no uncommon sight to see twenty or thirty observation balloons in back of the Entente lines, floating in perfect serenity, while in back of the German lines one or two kite balloons have been raised in feeble answer.

Of late it is understood that the British and French airmen are employing some sort of fire bombs, which are dropped in large quantities on captive balloons.

Practically every observation balloon carries a parachute for each observer, for this means of escape to the ground is often the only one in the thousand-and-one emergencies met with in actual service. For instance, it sometimes happens that a balloon breaks away from its moorings, and a high wind blows it toward the enemy. In such case the observer must make use of the parachute to land. Then again, when the gas bag is set on fire by enemy airmen, escape is only possible by means of a parachute leap.

During clear weather the observation balloon is reasonably safe from the attacks of enemy airmen, for it is decidedly unhealthy for the latter to come within range of the anti-aircraft artillery clustered below the balloon. But during misty weather and when the clouds are low the captive balloon has much to fear from hostile aeroplanes, which may be lurking behind clouds until the moment is favorable for a surprise attack followed by a quick retreat to the protecting mists. The greatest security of the observation balloon is not, as would be supposed, to haul it to the ground; for if such a procedure were followed out it would only be necessary for the airmen to consult his map and altimeter to know his exact height above the target and release his bombs with a fair chance of scoring a hit. The measure of defence in this instance, therefore, is to haul down the observation balloon a few hundred meters, making the task of the bombing airmen a matter of mere guesswork with consequently little chance of success.

However, by far the greatest protection for observation balloons rests with the mastery of the air; that is to say, the side having the greatest number of aeroplanes at hand is able to protect its kite balloons from attack.



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Immediately after the hit has been scored. Note the aeroplane and the parachute

The balloon, enveloped in flames, is fast reduced to a shapeless mass

Wreckage of the observation balloon falling to earth, with a smoke trail in its wake

Three phases of a successful attack on an observation balloon

New Styles of Light Machine Gun

THERE is great activity, just now, in the development of machine guns, and particularly of the type which, because of its light weight, can be carried forward by troops in making a rush at the enemy. The gun we show in our illustration belongs to this class. Its weight is about twenty-five pounds and, for a short while, it can be used as a shoulder piece. The magazine, which holds two rows of cartridges, slips into place very rapidly. This is one of the good features of this gun, and we are told that during a recent official test it was found that the magazine could be adjusted as quickly in the dark as in the daylight.

The gun is of what is known as the gas operated type—that is to say, a small portion of the gases of discharge pass out of the gun through a small hole in the bottom of the bore, near the muzzle, and acting on a piston, serves automatically to perform the work of loading, firing, etc. The maximum possible rate of fire is stated by the manufacturers to be 600 shots per minute.

Perhaps the most notable novelty in this gun is the attempt to apply the water-cooled principle to a light gun, thereby combining the good points of the heavy Maxim, which might be called a machine-gun of position, with the lightweight of the Lewis gun. The method of cooling is as follows: The barrel is encased in a jacket of such diameter as to provide a water space entirely around the barrel. The supply of cooling water is contained in a rubber bag, and circulation is secured by pressing the bag, either under the arm or by the foot, and forcing a certain amount of water through the cooling chamber and out through the tube near the muzzle of the gun. At the outer end of this tube is a sponge, the object of which is to condense any steam which is formed by contact with the hot barrel and thus prevent the location of the gun from being revealed to the enemy. The test by military men showed that the water boiled in about forty rounds; but we have been informed that the gun may be considered a "good" gun. Its manifest drawback is the rather long lengths of tubing and the bags, etc., which would be a serious handicap to the machine gun squad when charging through broken down, barbed-wire entanglements. However, this is a gun which has sufficient merit to warrant further experimentation and development.

The 25-pound machine gun in action

Using the light machine gun as a shoulder piece

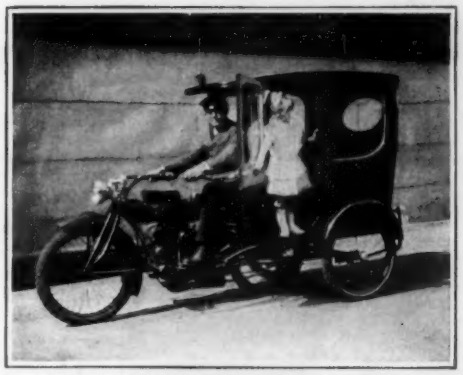
Vegetable Ivory as a Cattle Food

THE United States imports annually from tropical America about 10,000 tons of vegetable ivory nuts, costing $1,500,000, for use principally in the manufacture of buttons. In the process of manufacture a considerable part of the nut is wasted in the form of sawdust, chips and turning. In foreign countries this waste has been mixed with other ingredients to be used as a cattle food. Indeed, it is said that in Germany vegetable ivory meal has been used as an adulterant in the manufacture of so-called concentrated feeds. With a view to finding a use for the meal in this country, Messrs. Beals and Lindsay, of the Massachusetts Agricultural Experiment Station, have made an extensive investigation of its chemical composition, digestibility and feeding value, the results of which are published in the *Journal of Agricultural Research*. They find that the energy equivalent of this material ranks well with other carbohydrate foods, and it possesses a fuel value equal to one-half that of soft coal. Sheep ate the meal readily when it was mixed with other grains and digested it very thoroughly. Cows ate it when mixed with other feed, without evidence of digestive disturbances. When fed as an addition to a basal ration, the increase in milk was sufficient to indicate positive value as a productive feed.

A Miniature Closed Car

A MINIATURE closed car developed by a New York motorcyclist, which makes the rear car available for winter, is of such utility that it may develop into a popular type. For light passenger service it would take the place of the hansom cab very nicely, as it has capacity for two passengers and is very easy riding.

This vehicle was constructed upon a standard rear car and cost six hundred dollars. The windows are of plate glass and access is had by two doors. The interior furnishing is artistic, being of ivory tinted silk with an electric light let into the top. There is a small electric lantern on the hood above the driver's saddle, which bears the initial of the owner.



The miniature closed car which is readily attached to any motorcycle

Front view, showing the motorcycle effect

This type of conveyance has several advantages: It is so small it is easily housed in a little shed, and its light weight makes it inexpensive to run. Tire cost is small for the same reason. As the motorcycle is readily detached, it is available for separate use when desired. These are practical points that make this "pocket sized limousine" desirable as a city car for winter use. Its inventor expects that it will soon be a familiar sight in New York streets.

Fair "Submarines" to Become Oil Tanks

THE "submarines" used on the Joy Zone of the late San Francisco Fair are to be put to an unusual use. These craft ran through a large tank of water at the fair, carrying passengers yearning for the sensation of an under-water ride without the attendant dangers of the real thing. When the army declined to buy them for use as armored cars, the owner decided to convert them into railroad oil tanks. The boats—there are two of them—have a considerable capacity for oil storage, and are, of course, leak-proof. Mounted on trucks they have the advantage of being portable.

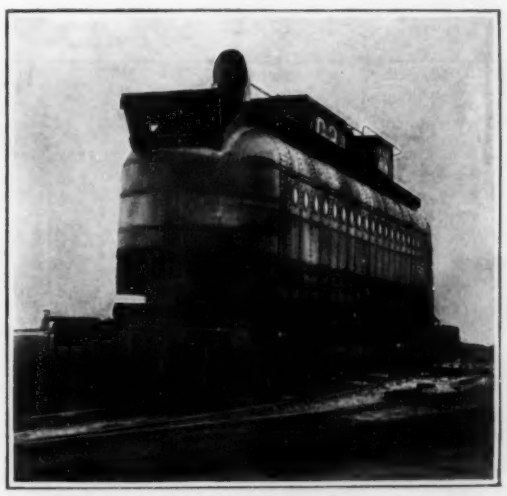
Paper Ribbon Films for Home Cinematography

By E. A. Dime

ALTHOUGH nowadays we have the so-called "non-inflammable" films of celluloid for motion picture projectors, and although Uncle Sam has recognized such films by opening the parcels post to it when packed in proper metal cases, if the celluloid strip could be dispensed with *in toto* practically all fire hazard would be eliminated. This would be of very great value in the home where, although certain miniature motion picture machines have found their way, they all have the disadvantage of making use of Rev. Hannibal Goodwin's invention—a transparent celluloid film. Then again, there is the all-important matter of low cost, for paper films cost but one-fifth as much as celluloid films.

The projector we are about to describe works upon an entirely different principle from the ordinary one. In place of a transparent film through which the powerful beams of a sputtering arc lamp pass, there is a paper ribbon upon which the light rays from thirteen 21-candle-power, circularly arranged incandescent lamps impinge, and from which they are reflected. So intense is the illumination upon each single picture of the paper strip, when it is in position, that it appears, as viewed from the front, to be a white-hot rectangle. As a matter of fact, however, a very large proportion of the red and infra-red rays of the spectrum—the heat rays—are absorbed by the ring of aluminum reflectors placed outside of the lamps for the double purpose of directing the light rays to the picture on the paper strip while at the same time absorbing the heat from the light and rendering the latter harmless to the paper when concentrated upon it. As over 95 per cent of the electrical energy of an incandescent lamp is dissipated in the form of radiant heat, one can readily see how important it is to absorb this heat, preventing it from reaching the paper.

To accomplish the desired result Mr. Hartwell Webb, the inventor of the new reflecting type of projector, utilized the investigations of Prof. Wood of Johns Hopkins University in selecting his reflector. Prof. Wood found that aluminum absorbed the red and infra-red rays to a greater degree than silver. Consequently the usual silvered mirror was dispensed with for one of



Built as a world's fair "submarine," now to be used as an oil tank

aluminum. The loss in illumination from the use of aluminum in place of silver is estimated to be about 20 per cent.

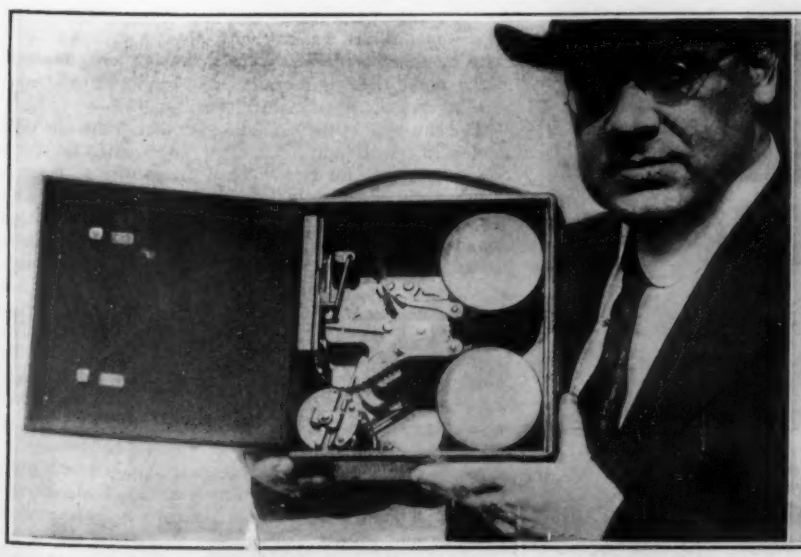
In the ordinary projector the available rays, emanating from the luminous point and passed through the usual 4-inch condenser, are only those within an angle of 30 degrees on each side of the central axis, or 60 degrees all told. This amount of light is utilized for the purpose of projecting the picture upon the screen. The pencil of rays passes to the projector with a light loss of about twenty-five per cent. In the Webb reflector on the other hand, the rays within an arc of 215 degrees are collected and reflected upon the "gate" from each of 13 lamps by means of ellipsoidal reflectors, so that approximately two-thirds of the total illumination sphere is collected and thrown forward in a converging beam. The result is fully as brilliant an illumination on the screen per watt of electrical energy expanded as that obtained by the ordinary projection method with an arc light. It is claimed that the new projector gives a hundred times the illumination per square inch of surface of any of the commercial reflecting apparatus at present on the market for projecting colored postal cards and the like. This, of course, is necessary because of the small size of the picture on a standard film, which is reproduced the same size on the paper ribbon used in the reflecting motion picture machine. As the ribbon can be stopped at any point when being run through the projector, any picture which it is desired to examine can be studied, so that all the advantages of the usual reflectoscope are retained, coupled with the delight of motion pictures of children, animals, or anything one wishes to photograph.

Prints on paper can be made from any standard motion picture negative film, but for home use a very neat camera has been devised in which the 100 feet of film and the shutter are actuated by a small 8-volt electric motor. Four cells of storage battery weighing but 8 pounds are carried in a separate case and used to run the motor. The camera is provided with a finder and an adjustable lens. To operate it all that is necessary is to press the button. It runs for two minutes and can be reloaded in daylight. The weight is but 8 pounds and the size 4½x9x9 inches. The shutter is made of tool steel only four thousandths of an inch in thickness It is extremely light and perfectly balanced. The film is moved forward intermittently by a harmonic cam, which is an excellent form of movement and makes possible the maximum exposure. A compact developing outfit is supplied with the camera, so that the amateur can develop and print his own pictures at home in any dark room of ordinary dimensions. To expedite matters, the negative can be made on bromide paper and then reversed in development to a positive, which can be run through the projector. This is in case one positive will suffice.

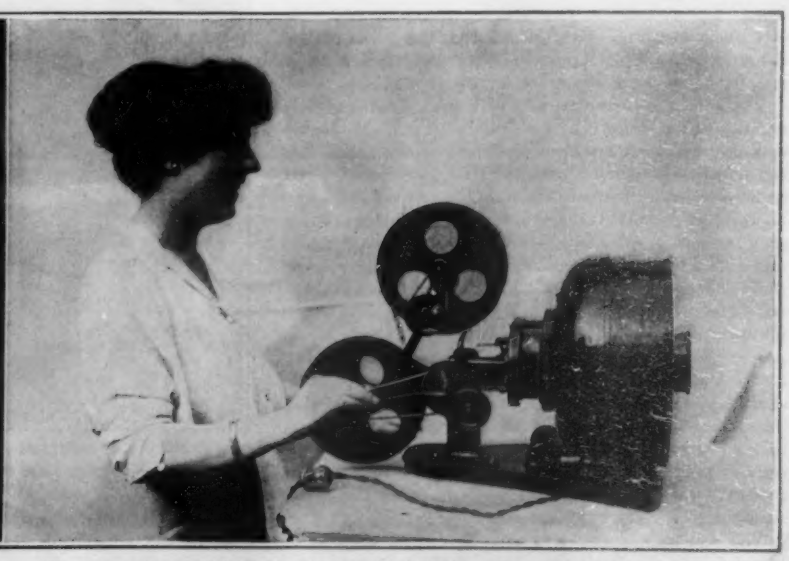
As the illustration shows, the projector is very simple and is operated by a crank. The lamps and reflectors are so arranged within a drum that they illuminate the one picture in place in the "gate," and this is thrown on the screen through a central lens. The film is carried on two reels in the usual way. A picture 3x4 feet in size and larger is practical; in fact, standard sized screen pictures for halls and theaters will soon be attained.

Refining Oils with Permanganate of Potash

SINCE pale colored oils are considered of better quality than dark or muddy ones, a special process of refining is employed for olive, linseed, poppy, fish, and other oils. According to *Por Esos Mundos* (Madrid) this is as follows. A kilogram of permanganate of potash (2.2 lbs.) in the form of small crystals is dissolved in 10 liters of water. This solution, of a deep purple color, is mixed gradually with 30 kilos of the oil to be refined and stirred repeatedly as smoothly as possible during a period of two days. At the end of this time there are added 20 liters of water and 5 liters of commercial hydrochloric acid at 20 to 22 degrees Baumé and it is stirred again energetically. Several days later the acidulated water is carefully decanted. To remove all trace of the acid it is treated with clear warm water and as a final operation is passed through a charcoal filter.



This motor driven motion-picture camera needs no tripod, and can be operated by the novice by merely pushing a button. It can be used with paper films



The expensive celluloid film is now banished as the one chief obstruction to motion pictures in the home. This machine uses paper films

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Electric Coffee Grinder for the Home

A REAL household need has been met with the invention of an electric coffee grinder for the home. This little machine, which is only 30 inches high by 7 inches wide, fastens to the wall conveniently near the electric light socket and is always ready for use.

The grinding of the coffee just before making, preserves its flavor for the drink, much of which is lost if ground by the grocer a pound at a time. Even if put into cans and waxed paper the aroma escapes soon after grinding.

This new coffee mill does away with the old-fashioned hand-mill which took so much time and energy. Now the lady of the kitchen can, by turning a switch, have the work done for her while she attends to other details of the meal. And the coffee is cut with tempered steel knives instead of being crushed.

The machine is quite an ornamental little affair and is substantially constructed of white brass with nickel plate.

Freshly ground coffee by the cup

A Phonograph Flashlight

AN electrical designer and inventor stationed at Milwaukee has developed and patented a flashlight illuminating instrument, which enables a person to play a talking machine record in the darkness of night or in a badly lighted room, easily, safely, and satisfactorily.

The device is somewhat like an ordinary searchlight. When in operation, the instrument is attached to the talking machine's tone arm, with cords coming out of its case, which also holds the hidden source of power.

With the illumination thus furnished, it is easy to place the needlepoint accurately at the proper place on the record.

Setting a phonograph needle in the dark by means of an electric flashlight

A Coal Meter That Is Built Like a Corkscrew

THERE has lately been developed a coal meter which will give a positive record of any ground or broken material such as coal, ore, cement, grain and similar substances. It was originally designed to check the boiler-room performance of a large railway plant in the hard coal fields of Pennsylvania, and it performed this work with such satisfaction that it was decided to build it for general boiler-room use.

The principle upon which the new coal meter operates is simple: The driving force of the coal meter is the full cross-section of coal in the pipe sweeping past the long spiral vane, shown in the accompanying drawing. This material exerts a powerful rotating force on the vane and each foot of movement of material will rotate the vane the same amount. The vane is obviously moving in proportion to the flow and as the recorder is driven by this vane its movement must also be proportional. It only remains to connect the vane with a recorder by proper gearing to give any units desired for the reading. It will be gathered from the above explanation that the driving force required for metering is far more positive with a granular substance than with the above mentioned materials. It is well known by those familiar with metering any substances such as gas, steam, air or water that certain conditions peculiar to the material being measured must be met. The one all-important condition for successful metering of granular material of any kind is that the movement of the material at the point in the pipe where the meter is inserted must be of the same nature at all times.

The new coal meter consists of a spiral rotating vane or "measuring ribbon"; a recording meter with a visible dial, and a frame containing shafts and gears connecting the spiral rotating vane with the recording meter. The spiral rotating vane is suspended in the center of the pipe or chute by the supporting frame. The discharge of this pipe, obviously, must be so controlled as to always maintain a solid body of material to be measured while passing the vane. As the coal or other material passes downward the spiral rotating vane is revolved in direct proportion to the amount of drop. This amount of drop is proportional to the weight of the coal withdrawn. The rotation of the vane is transmitted by means of suitable shafts and gears to the counter operating the visible dial. The meter is always calibrated under actual conditions and a constant obtained. The number of teeth on the counter at the time of calibration divided by the constant gives the required number of teeth to make the meter read correctly with the scale selected.

The soft-coal meter was not developed until some months after the hard-coal meter had been in successful operation. It was necessary to make some changes to overcome the interference of lumps striking the cutting edge of the vane. The latter was narrowed down so that it would be sheltered by the body of the meter. This simple precaution has overcome all the detrimental effects of lumps on the movement of the vane and it only remains to provide ample room for the largest lumps to pass the meter without clogging the pipe. Where coal is crushed for stoker use there is no difficulty from this source when the pipe is 12 or 14 inches in diameter.

A battery of automatic stokers provided with a new form of coal meter

The "Harmless" Modern Military Rifle

IT will shoot from "machine rest" or the hands of a skilled rifle shot, into a 2-foot circle at 1,000 yards. It has put, in the hands of an American marksman, 14 bullets out of 15 into a 3-foot circle at 1,200 yards, with the one remaining shot in the next adjoining ring, 9 inches wide. It is powerful enough to kill cleanly at a mile. Fired at a mark 500 yards distant, or 60 yards more than a quarter-mile, its bullet rises in its flight less than two feet above the line of sight; so it would, in its travel, hit a kneeling man anywhere from muzzle to mark.

All this is what the modern rifle can do. What it does do is this:

The highest fighting record it can show in modern wars between large bodies of troops, was made in the first attempt of the British to cross the Tugela river in the Boer War. Firing from comfortable trenches, over ground previously measured and over which the ranges were known and spotted to the last inch, and firing at troops advancing in semi-close order in open country, the Boers scored one hit for every 700 shots fired. There may be record of higher scoring in the war now going on, but if so it has not been reported.

The worst shooting the world ever saw is said to be that of regular Moroccan troops in an attack on the stronghold of Raisuli, the bandit. The troops fired 80,000 rounds and didn't score a hit.

The German theory of fire discounts any idea of individual accuracy; it treats of zones and spraying positions with rifle fire as one would spray a spot on the lawn with a hose. Sometimes this is all that can be done when the other chaps are in cover, and there is nothing at which to fire but a spot on the landscape. When the Germans make their attacks, however, there is no lack of things at which to shoot, and the highly trained British regulars, in the eventful days of 1914, took full advantage of the chance.

Even with things at which to aim, and with the problem uncomplicated by the distracting influence of the other fellows shooting back, space has a large and powerful attraction for the bullet; and there is plenty of space around the largest of marks.

Several years ago a war strength battalion of American regular infantry, 400 men, gave a field firing demonstration on targets arranged to simulate what in those pre-war days they believed an enemy would be to the eye. They advanced in normal order from 1,200 yards and they fired on a line of figure targets, on lines of disappearing targets, on lines of flanking targets suddenly appearing on either side, and finally on running targets, arranged craftily on a sledge hauled by a cable. The total score up to about 400 yards, where the advance ceased, was just 10 per cent of hits, one hit every ten shots; and this was by highly trained, cool, regular infantrymen under skilled officers, with nobody shooting back, with no high explosive shells bellowing and throwing rocks upon their immediate front—in a word, with nothing to distract or disturb them.

The flat flight of the modern bullet makes the rifle very useless in trench fighting at close range unless the mark kindly gets up into view. There is no way to make a high velocity military bullet travel from one trench into another 100 yards or so away, while the trick of lofting tangible compliments into the trench of the other chaps is easily performed by giving the projectile just enough start to describe a high parabola into the air and fall into the nearby trench.

Because of the necessity for firing approximately the weight of a soldier in bullets before the chance shot kills him, and because of the lack of accuracy of average infantry fire despite the accuracy of rifle-fire at a visible mark by a skilled shot, the machine gun is steadily displacing the infantry rifle in its own field. Firing the same ammunition and requiring but three or four men to run it, the machine gun throws the same number of bullets per minute as 60 infantrymen, while the skilled machine gun pointer can put the spray just where he thinks it is needed—wher it is sure to do greatest execution—which is almost impossible with infantry.

The Dangers of Eating Insufficiently Cooked Pork Products

EAT no pork or pork products unless they are cooked, if you would be certain of avoiding trichinosis. This is a warning issued by the Bureau of Animal Industry of the United States Department of Agriculture, especially to those who around the holiday season are in the habit of eating raw ham or special forms of sausage containing raw pork and made to be eaten uncooked. The records show that the number of cases of trichinosis—a serious, painful, and often fatal disease resulting from trichinæ—increases during the holidays, partly because of hog-killing time and partly because farmers frequently make up special forms of sausage which are eaten without cooking.

To avoid trichinosis no form of pork in the raw state, including dried or smoked sausage and hams, should be eaten. All pork used should be cooked thoroughly, as trichinae, the minute organisms which cause this deadly disease, die and therefore become harmless when subjected to a temperature of 140 deg. F. or higher. The fact that these organisms may remain alive and active in uncooked pork makes the latter, say department meat specialists, a menace to life and health.

Everyone should remember this simple rule of food hygiene: Cook pork well. A practical rule is to cook pork until it has lost its red color throughout all portions, or if a trace of this color is still present, at least until the fluids of the meat have become more or less jellied.

The Federal meat inspectors do not inspect pork or pork products to determine the presence or absence of the organisms causing trichinosis, as even careful microscopic examination is unreliable. In inspected establishments the inspectors do, however, require that pork which is to be made into products to be eaten raw shall be heated sufficiently or subjected for considerable periods to extreme cold to destroy the harmful organizations. This requirement does not reach all pork products made to be eaten raw, since the Federal government inspects only products to be shipped in interstate commerce.

It should be noted that the special treatment required by the Bureau of Animal Industry to be given pork products meant to be eaten raw must not be interpreted as an indorsement of such dietetic practices. The measures are taken primarily to reduce the risks taken by persons who ignorantly, carelessly, or wilfully eat such products. It remains that the safest plan is to eat no pork products of any kind raw.

Welding Tool-Steel Tips to Machine-Steel Shanks

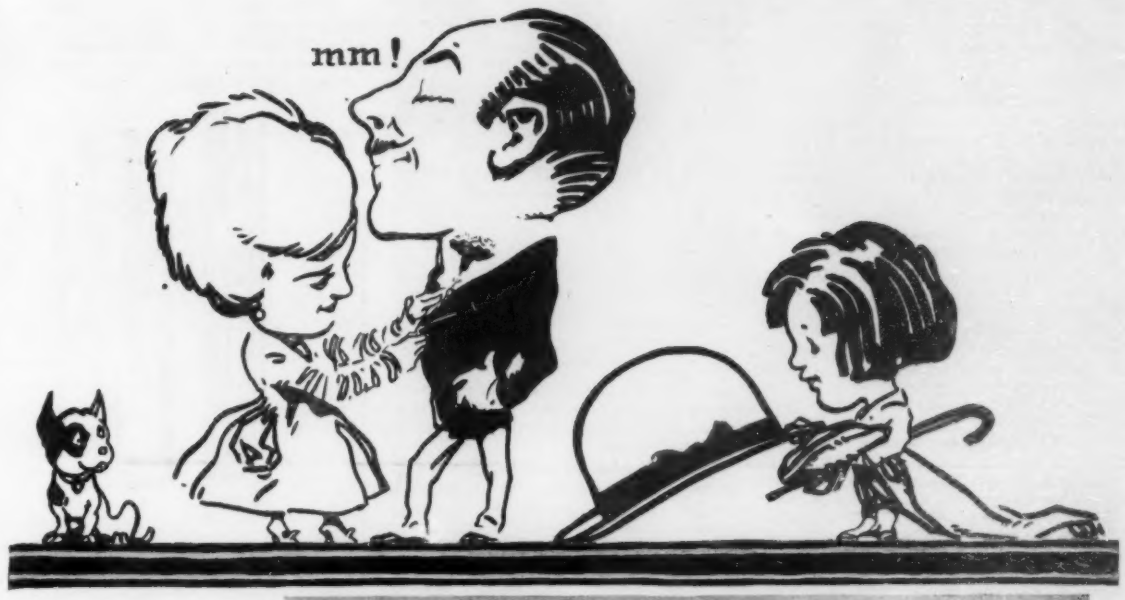
THE constantly increasing price of high-speed tool steel now makes it almost prohibitive for the average shop to use cutting tools composed wholly of such material. Furthermore, with high-speed steel at present prices it is very costly for a shop to have to scrap worn out tools. Such problems, however, can now be solved and noticeable economies effected by welding high-speed steel tops to ordinary machine-steel shanks. Thus old worn out high-speed steel tools can be cut to proper size and utilized for tips at a great saving.

Briefly, the process employed for the work is as follows:

The high-speed steel tip is first "tacked" to the machine-steel shank, and the whole preheated. After fluxing with borax, welding is started. After welding, the tool is immediately laid in mica dust to cool gradually. It is then given a first grinding and tempered, after which the finish grinding is accomplished, when the tool is ready for use. It will be noted that the process is a simple one.

A good practice is to use reinforcing metal, which is built out and around the tip, serving both to give larger radiating surface and to afford a larger conducting path back to the butt of the tool, thus keeping down the temperature at the cutting edge. The machine-steel shank may be of any length desired, and of cold, hot rolled, or carbon steel, while the high-speed steel tip should be short.

(*Concluded on page 109*)



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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

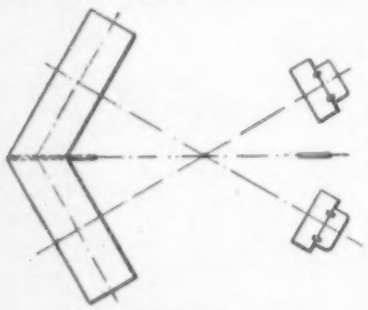
Pertaining to Apparel

INSOLE.—T. N. PHILLIPS, 554 Hudson St., New York, N. Y. This invention is an improvement in insoles which are particularly designed and adapted for use in rubber boots and comprise leather and sheet metal layers suitably secured together. Means provide for holding the wearer's foot against sidewise movement and support the arch for firm foothold on rungs of a ladder.

DRESS VEST.—M. ROLLNICK, 321 Fifth Ave., New York, N. Y. The object here is to so construct a vest for use in connection with dress suits that the shirt front will be prevented from bulging outward or between the lapels of the vest, the side portion of the vest being arranged so as to bulge far enough to compensate for the tendency of the shirt front to bulge when the man is in a stooping position.

Pertaining to Aviation

AEROPLANE.—H. L. COAKLEY, 207 W. 14th St., New York, N. Y. This invention has reference more particularly to a combination of fixed and movable parallel planes, the axes of which are disposed angularly. The correct principle of spiral control and stability is employed in this aeroplane where portions of its wings in angular arrangement with one another with relatively proportional controlling surfaces are similarly



AEROPLANE

arranged in the rear thereof, so that when portions of the aeroplane have different tendencies to guide to the right and left each of these tendencies are always stable, therefore any sum and difference of these guiding tendencies which would cause the aeroplane to steer in greater or less spirals will always cause any amount of spiralling either to the right or left, to be stable.

Electrical Devices

CONTINUOUS TROLLEY CONNECTIONS FOR BRIDGES.—T. JENKINS, 149 Willis Ave., Bronx, N. Y. The invention provides a connection arranged to insure a proper electric connection between the land conductor and the bridge conductor with a view to avoid a break in the car circuit at the time the car passes from the line onto the bridge or off the latter back onto the land, and to allow convenient opening and closing of the bridge without requiring handling or other adjustment of the connection.

Of Interest to Farmers

SHEEP HOOK.—H. E. NEWMAN, Salmon, Idaho. This invention is an improvement in the class of telescopic sheep-hooks, and the feature of novelty is the joint formed between the hollow, slidable, telescopic sections comprising the pole or

SHEEP HOOK

handle of the device. The engraving shows the invention in part a side view, and in part a longitudinal section of the sheep-hook when telescoped or collapsed, and reduced to its shortest length

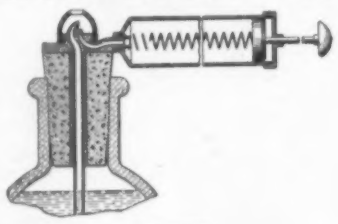
BEE ESCAPE.—C. D. CHENEY, 905 Washington St., Hoboken, N. J. The invention provides a bee escape composed of comparatively few parts and arranged to provide a free escape of the bees and one which is not liable to become ineffective on account of the deposit of propolis by the bees or by the accumulation of dead bees.

Of General Interest

APPARATUS FOR DESTRUCTIVE DISTILLATION.—J. W. BARNES, 904 Lyons St., Lake Charles, La. This invention relates to improvements in apparatus for destructive distillation, especially the destructive distillation of wood. It provides a device by means of which the destructive distillation of wood or other similar organic bodies may be carried out with greater economy than before.

METHOD FOR MOLDING TILES.—A. F. LEWIS, 10 State St., Santa Barbara, Cal. The inventor provides a method and means whereby tiles may be produced with facility and with accuracy as to the desired shape, and whereby the finishing of the tile can be completed at once after the molding, and the tile maintained moist while curing, thereby doing away with the necessity of watering the tiles until after they have been removed from the molds.

ATOMIZER.—R. H. CALLAN, 303 E. 8th St., Trenton, Mo. The invention relates more particularly to a stopper, supporting atomizing means, and adapted to constitute a closure for an



ATOMIZER

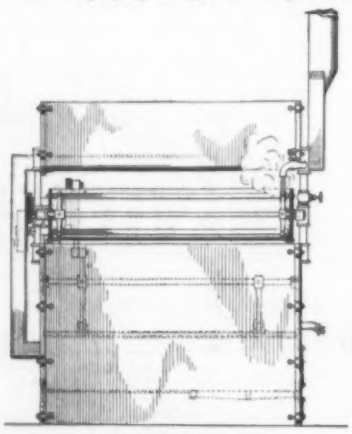
ordinary bottle adapted to contain perfumery or other material to be atomized. It provides an atomizer adapted for bottles of different sizes within certain limits.

Hardware and Tools

COMBINED PAPER WEIGHT AND PENCIL SHARPENER.—S. M. STEVENS, 1 Ravenscroft Road, Asheville, N. C. This invention is particularly adapted for use as an advertising device, in which the paper weight presents panels available for advertising matter. In carrying out the invention also the top of the paper weight is made to constitute a receptacle for the parings produced by the pencil sharpener.

Machines and Mechanical Devices

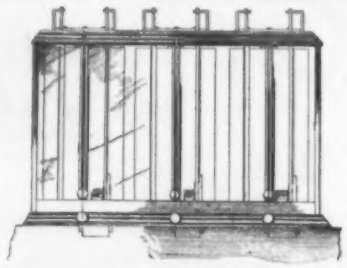
LIME SULFUR MACHINE.—H. V. HART, care of Hart & Massey Co., Winchester, Va. This improvement provides a device which can be economically operated for mixing lime and sulfur to form a spraying compound. It provides a



LIME SULFUR MACHINE

device which takes up very little room because of the fact that the water heater is located above the mixing tank in a position to receive heat which would otherwise be wasted, this water heater furnishing the necessary supply of water for the mixture.

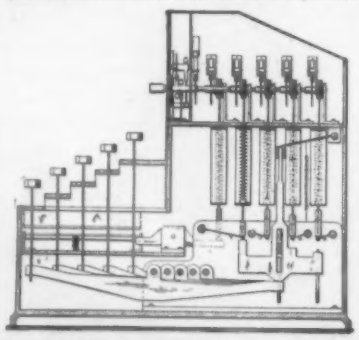
VENDING MACHINE.—F. H. COX, Gratton, Va. An object of this invention is to provide a vending machine including a lock mechanism of



VENDING MACHINE

novel construction and consisting of a locking member which normally assumes a locking position whereby any adjustment of said mechanism is prevented until the insertion of a coin into the same and after the extraction of a card said member is again automatically adjusted to locking position.

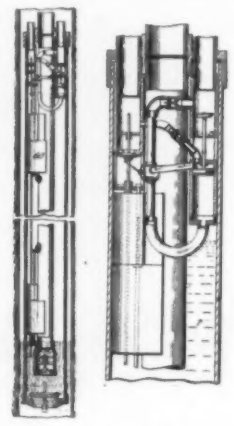
MONEY SEGREGATING DEVICE.—H. HERDEN, Wellsboro, Pa. The mechanism of this device provides for rapid segregation of individual amounts of wages of a weekly pay-roll into required denominations with the least expenditure



MONEY SEGREGATING DEVICE

of mental and physical effort, showing in a register above the keyboard the total number of each denomination in bills and coins necessary to be drawn from a bank.

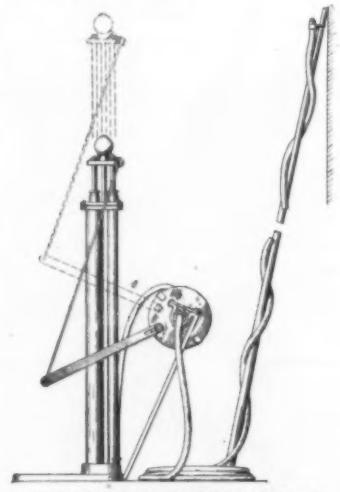
PISTONLESS PUMP.—J. M. PRESSLER, 501 First National Bank Bld'g, Jacksonville, Tex. The present invention relates generally to pumps and more particularly to water pumps though capable of use in connection with other fluids, the



PISTONLESS PUMP

primary object being to provide an effective pistonless pump in order that it may be adaptable for use without undue wear in localities where sand predominates with the fluid to be pumped.

DUST GERMICIDE SPRAYING APPARATUS.—H. A., J. E., L. and O. L. RICHTER, 1001 York St., Utica, N. Y. This invention pertains to an apparatus for spraying powdered germicide on trees or garden plants for protecting the same

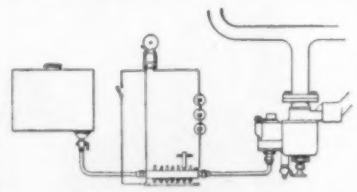


DUST GERMICIDE SPRAYING APPARATUS

against disease, insects or other destructive agencies. It provides a spraying device in the form of an attachment for an air pump, so that by the operation of the pump the powdered germicide can be sprayed on trees or plants.

Prime Movers and Their Accessories

CONTROL APPARATUS FOR FUEL SUPPLY FOR INTERNAL COMBUSTION ENGINES.—T. F. CASEY, 75 Greenwich Ave., New York, N. Y. This invention prevents an unauthorized supply of fuel to an internal combustion engine; provides a combination lock for controlling the flow of fuel to an internal com-



CONTROL APPARATUS FOR FUEL SUPPLY FOR INTERNAL COMBUSTION ENGINES

bustion engine; provides an audible alarm actuated by said lock when tampered with; and provides a poly-membered means for determining the supply of explosive fuel to internal combustion engines, said members being disguised in arrangement.

Railways and their Accessories

BOLT.—T. HAND, P. O. Box 663, New Haven, Conn. The invention has particular reference to a locking bolt used in connection with railroad frogs. An object is the provision of a novel construction of nut lock designed to be used in connection with the bolt which will also assist in securely retaining the latter in locked position.

RAIL JOINT.—T. HAND, P. O. Box 663, New Haven, Conn. This invention relates more particularly to a simple accepted type of joint including certain structural improvements, the object of which is to increase the strength and desirability of the several parts, as well as to prevent all danger of their relative displacement in use.

DUMPING FREIGHT CAR.—H. A. STURNI, 367 E. 160th St., Bronx, N. Y. This invention relates to railway rolling stock. It contemplates the provision of a car bottom normally horizontal in closed position but adapted to be dropped or lowered along either side for discharging the contents of the car laterally at such side.

Pertaining to Recreation

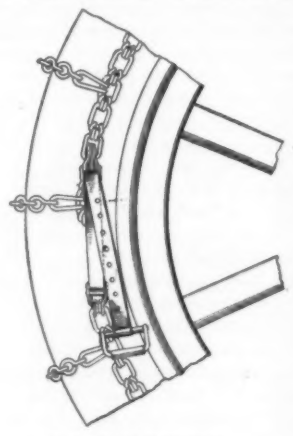
ROLLER SKATE.—T. SPACIE, 311 S. 5th St., DeKalb, Ill. In this instance the invention relates to games and toys and has particular reference to skates made chiefly of sheet metal. Among the objects of the invention is to improve this class of devices whereby they may be cheapened in construction without materially affecting their reliability.

TOY BLOCKS.—R. E. HUMBERT, care of Baker & Bennett, 873 Broadway, New York, N. Y. This invention relates particularly to toy blocks from which various figures may be assembled, combinations that represent in odd or grotesque shapes, human or other animal forms and birds. It provides a head block having a novel arrangement of eyes, whereby various expressions can be obtained, and a special form of nose which can be adjusted to different positions also for varying the expression or appearance.

FISHING DEVICE.—S. A. SEVERTSEN and L. D. SCHWAB. Address, Owen E. Hulehan, Deer River, Minn. This invention provides mechanism of simple form for opening and holding open the mouth of a fish, for facilitating the extraction of the hook, wherein means is also provided in connection with the said device for permitting the fish to be easily scaled and cleaned, and for handling the fish in general.

Pertaining to Vehicles

TIRE CHAIN TIGHTENER.—G. E. WIGHTMAN, 90 Eleventh St., Portland, Ore. Mr. Wightman's invention provides a simply constructed toggle for use in pulling the ends of tire chains together and for holding them in position



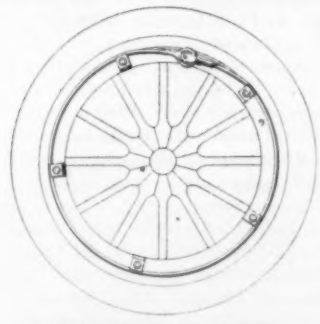
TIRE CHAIN TIGHTENER

while being coupled. This is a much needed accessory and it makes this task an easy one and insures the proper adjustment of the chains. The engraving shows a fragment of a wheel provided with a chain, to the ends of which the tightener is secured for drawing the ends together so that they may be connected together by a link.

SPOKE.—C. F. MENGE, Hickory and Schuyler Sts., Utica, N. Y. In this case the object is to provide a simple, strong and inexpensive spoke which will have a higher resistance to fatigue than the ordinary wire spoke. This object is attained by providing a layer of material softer than the material of the spoke at the head of the spoke.

AMBULANCE.—R WILLIAMS, 308 W. 133d St, New York, N Y The invention relates especially to those automobiles designed for army or other field use where a number of patients may be received and transported at the same time. It provides an ambulance having facilities for surgical attendance and assistance while the vehicle is in the field or on the way to the hospital.

DEMOUNTABLE RIM RETAINER.—C. L. ADAIR, Benton, Pa. This invention relates to resilient tires and wheels, and has particular reference to demountable rims for pneumatic or other replaceable tires. Among the objects of the invention is to provide a quick and easy means



DEMOUNTABLE RIM RETAINER

for manipulating demountable rims or the like. It provides in connection with the demountable rim, a hook-like retainer with means for quickly applying the same in position and tightening for locking the rim in place.

Designs

DESIGN FOR AN EMBROIDERED TRIMMING.—A. S. FREED, 256 Fifth Ave., New York, N. Y. In this ornamental design the embroidered trimming comprises an original and attractive arrangement of small black and white squares massed in certain parts, and another part composed of flowers and leaves.

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Welding Tool-Steel Tips to Machine-Steel Shanks

(Concluded from page 107)

One company which is at the present time using cutting tools with high-speed steel tips and machine-steel shanks for many of its planers and lathes, has found the electric arc process of welding most satisfactory and considerably cheaper than any other process, this conclusion be reached after tests were conducted with oxyacetylene and forging methods. The ordinary electric arc welding equipment used for this purpose is the same as that required for the welding or repairing of castings. For best results the current for this work should be approximately one hundred amperes, and the voltage of the welding circuit sixty to seventy volts. A $\frac{5}{32}$-inch Norway iron electrode should be used.

The work of welding machine tools should not be hurried, but a good operator should be able to make between twenty-five and thirty welds for tools of 1½-inch cross section in a day of 9½ hours.

New Process for Manufacture of Artificial Milk

A WIDE range of nature's products have recently been reproduced in an effort to combat the relative scarcity and high prices of commodities known as the necessaries of life. A careful analysis of the article to be imitated has often revealed the fact that its constituent elements may be assembled from the vegetable and mineral worlds. Synthetic processes formulated in the laboratory are demonstrating their practical utility in the factory, and the science of substitution is becoming a great factor in English industry.

A recent patent application in England is based upon a process for the manufacture of artificial milk for human consumption. It is claimed that a wholesome and inexpensive substitute can be made from peanuts, soya beans, water, sugar, water and the mineral salts found in milk. In commenting on this new process the *Yorkshire Observer* gives this synopsis:

In 200 pints of pure water at 80 deg. C. (176 deg. F.) are dissolved 400 grains of potassium phosphate, or the equivalent amount of sodium phosphate; sufficient sugar is added to give 4.5 per cent to the finished milk and 40 pounds of meal prepared from nuts, blanched. The solution is boiled in a steam-jacketed pan, then subjected to the operation of a vacuum pan, and finally treated with a culture of lactic bacteria until the required acidity is obtained. It is afterwards pasteurized at 60 deg. to 70 deg. C. (140 deg. to 158 deg. F.) for at least 20 minutes, cooled and stirred, while 0.05 to 0.11 per cent of citric acid is added.

The milk so produced, it is stated, may be condensed and sold in tins in the usual way or dried to a powder and sold in bottles. It may be given a certain percentage of cream by the addition of cocoanut or one of the other tasteless nut fats, the fat being added when the substance is in the vacuum pan. It may be cultured by the aid of lactic bacteria to give a table cream or a soured mass for making into cheese. The residual meals, rejected after the special factors required have been taken from them, are mixed, dried until they contain only 10 per cent of water, and used as food for cattle.

A Novel Periscope

A "PERISCOPE for track inspection" is the name of a handy new instrument devised and used by engineers making an inventory for track work on the Queens elevated lines in New York City. It is very simple, consisting merely of a small hand mirror fastened to a stick about three feet long. It has been found invaluable for inspecting and counting the hook bolts, lag screws and all other track material located under the ties. The men engaged on this work dubbed the device a "periscope." The original has been improved by cutting the handle about three inches from the mirror and joining it with a thumb-screw in such a way that the mirror may be set at any desired angle.

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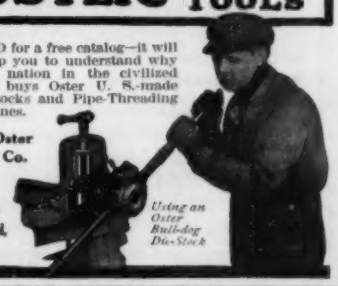

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Under Fire at Verdun

WALTER HALE has had the unique privilege of visiting Verdun during the momentous days of its siege, and of contrasting the beleaguered, shell-torn city of to-day with his recollections of it during a visit five years earlier. MR. HALE was accorded unusual courtesies by the French army commanders at Verdun, by whom he was entertained. He is the first war correspondent permitted to sleep in the citadel. He has made some remarkable drawings, contrasting the Verdun of five years ago with the city as it is to-day.

The Prophet from America

M. E. RAVAGE, a young American of Rumanian birth, has written a most striking and unusual narrative of the return of an emigrant to his native land, and the vision of America which he pictured to his fellow-countrymen, which resulted in an almost nation-wide exodus to the United States.

New Facts About Pneumonia

By BURTON J. HENDRICK. It has recently been proved that there are really four kinds of pneumonia greatly differing from each other in their origin and effect. This is but one of a notable series of discoveries recently made at Rockefeller Hospital which are revolutionizing medical knowledge, and which are described in interesting detail by MR. HENDRICK.

On the Crest of the Lost Atlantis

Of the little visited Azores, none is more interesting than San Miguel, a tiny island honeycombed with geysers, hot-springs, and "devil's cauldrons." CHARLES WELLINGTON FURLONG vividly describes these strange volcanic activities and the picturesque life of the people. Illustrated with photographs.

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New Process for the Recovery of Sucrose from Final Molasses

THE invention of a new process for the recovery of sucrose from final molasses, which would mean a quantity gain of at least 3½ per cent in the commercial sugar crop of the Hawaiian Islands, was reported to the meeting of the Hawaiian Sugar Plantation Association on December 6th by the inventor, J. N. S. Williams, field engineer for a local company. The new process takes from the so-called "final molasses" approximately one-half of the 8 per cent of sugar that heretofore has been considered absolute loss.

The additional cost for machinery will be slight, says Mr. Williams. But in the long run, he adds, it will involve no additional cost to produce 3½ per cent more sugar by the new process than is now taken from the juice in the production of second, third and fourth sugars. The process, he claims, will produce in one operation what now takes three operations, and at the same time will yield the additional sugar.

Mr. Williams' experiments with this process have extended over two years. The results, as summed up, are that final molasses boiled to 99 per cent Brix will develop small grains representing practically the whole of the sucrose present in the molasses; that this grained sucrose can be recovered in large quantities with suitable equipment, and that this recovered sucrose may be converted into a marketable product.

The principle on which Mr. Williams has worked is that it is not the glucose gums or ash, but solely the water in molasses that has prevented the sucrose therein from crystallizing. By removing the water, then, is the only method by which it can be made to give up its sucrose, he believes. This is the first step in the process—boiling the molasses to a practically complete absence of water. The next important departure in the new process is the use of a high-speed centrifugal which is said to have a running speed almost twice as great as centrifugals ordinarily show.

Successful Use of Nettle Fibers in Cloth Making

SUCCESS is claimed for the project to substitute the fiber of the stinging nettle for cotton in the production of cloth. Dr. Richter of Vienna, who was responsible for the efforts to utilize this fiber, is quoted by a local journal as stating in the course of a lecture on the progress of his research that all the conditions for a profitable production have been found, and that Germany and Austria, by means of a methodical cultivation of the nettle, could make themselves entirely independent of the cotton producers. The journal says further:

Three conditions are necessary for a successful cultivation of the nettle: Sufficient moisture, shade and enough nitrates in the soil. These conditions exist in the river valleys and deciduous forests of Australia and Hungary. Nor is there any necessity for the use of fertilizer, an important matter when the profitableness of the undertaking is considered.

During 1915 and in the spring of 1916 experiments were made in the cultivation of the nettle in numerous districts along the Danube in Austria and Hungary, and all with splendid results. As a result of these experiments the question was taken up whether there was in Austria and Hungary a sufficient area of suitable soil which does not come into question for the cultivation of other products. Prof. Marchet has through thorough investigation established the fact that in the Niederwald in Austria there are 10,000,000 acres, splendidly adapted to the cultivation of the nettle.

According to Dr. Richter's estimates this is twice the area needed to produce sufficient nettle fiber to replace the cotton imports of both Germany and Austria-Hungary. Samples of cloth which were shown are considered by him as proof that fabrics can be produced from nettle fiber without any admixture of cotton.

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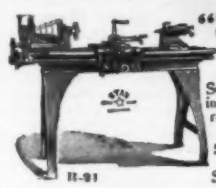

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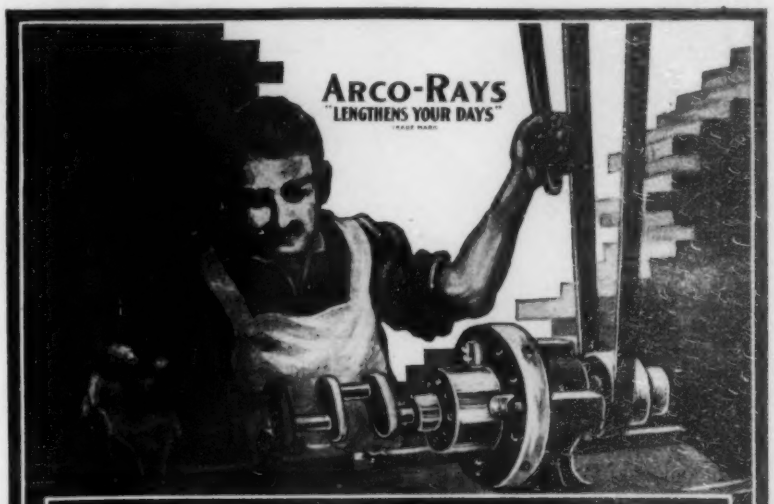

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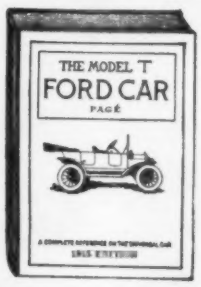

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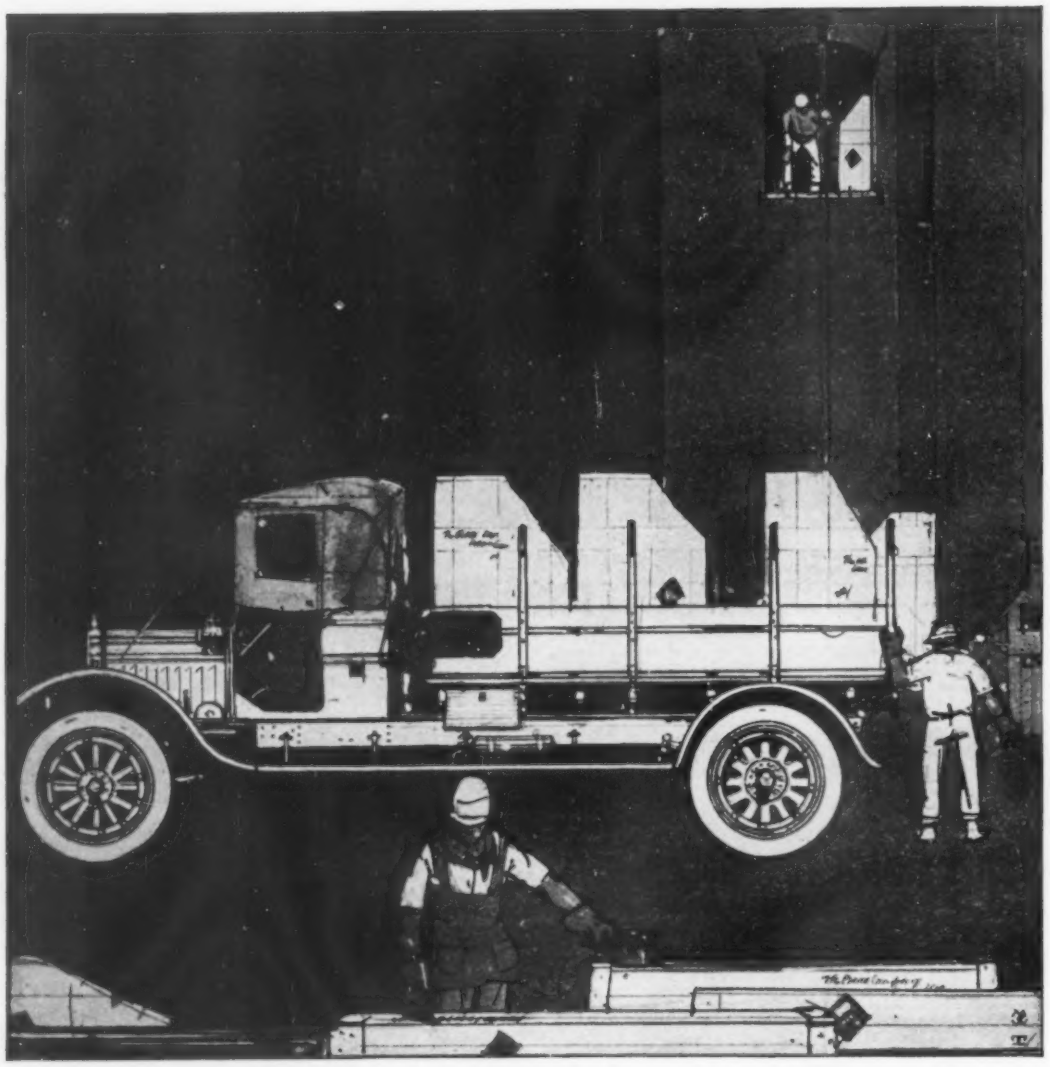

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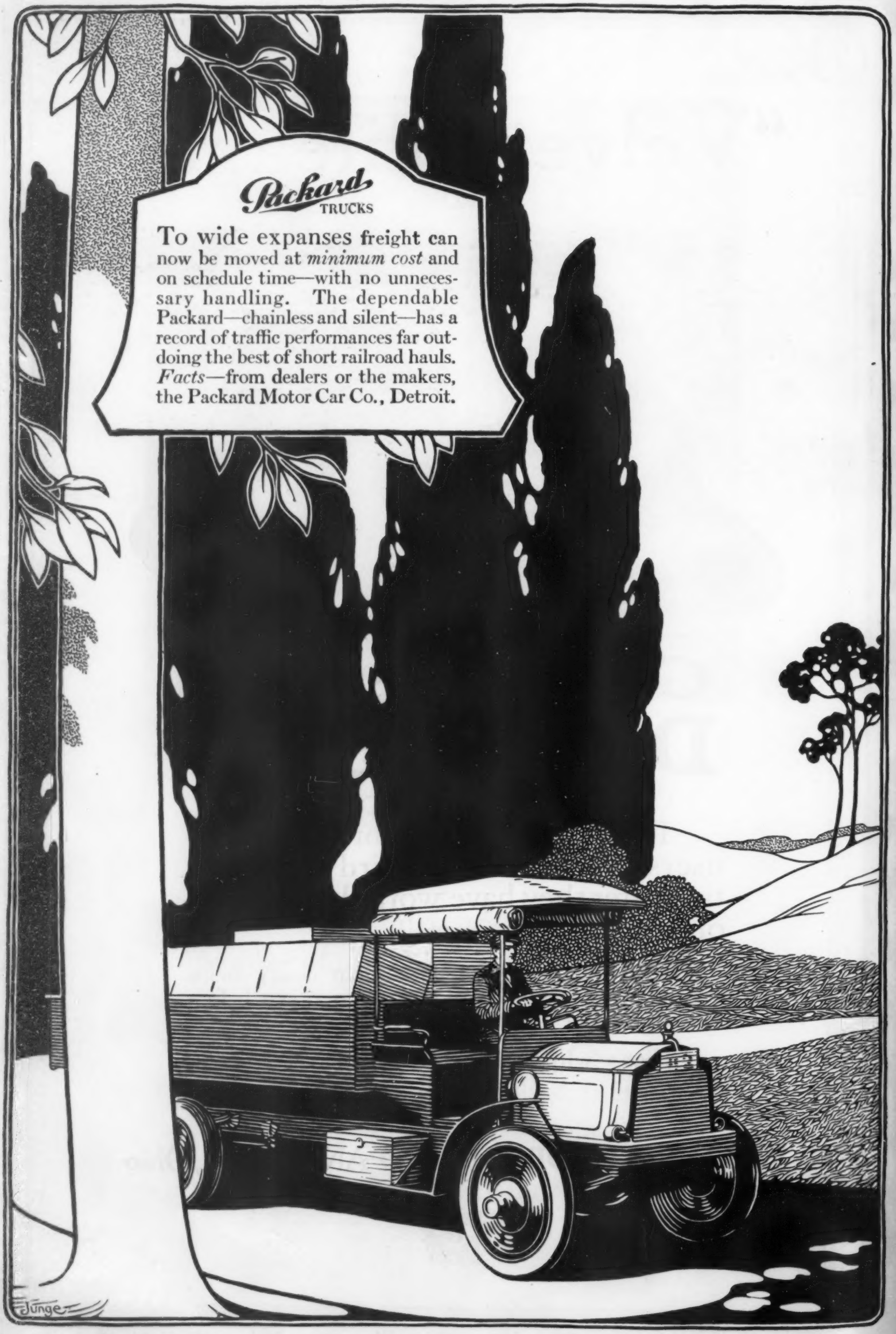
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